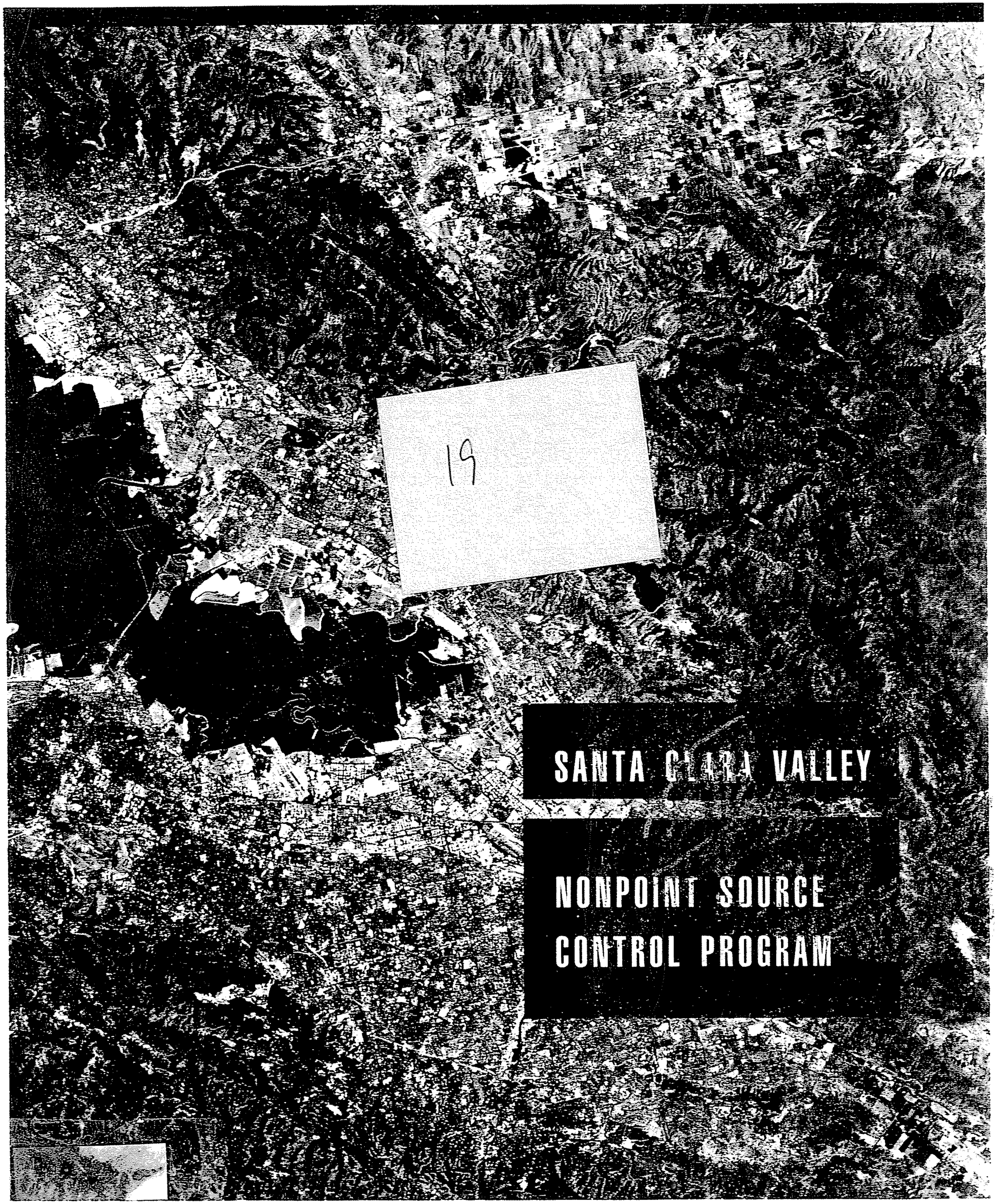
Loads Assessment Report
VOLUME I/FEBRUARY 1991



19

SANTA CLARA VALLEY

NONPOINT SOURCE CONTROL PROGRAM

PROPERTY OF SANTA CLARA VALLEY
WATER DISTRICT
5750 Almaden Expressway
San Jose, California 95118

1.4.805-1
VI

TD
424.35
S383.S38
1991
V.App.

TD424.35 S383538/1991/appc.2

Appendices

Santa Clara Valley Nonpoint Source Study

Volume I: Loads Assessment Report

Submitted to

Santa Clara Valley Water District

February 22, 1991

Submitted by

Woodward-Clyde Consultants

in associated with

Kinnetic Laboratory, Inc.

8720115A

TABLE OF CONTENTS

Section — Page

A FIELD MONITORING PROGRAM A-1

B HYDROLOGIC MODEL CALIBRATION AND VERIFICATION B-1

C SUMMARY OF LABORATORY QA/QC C-1

D SANTA CLARA NONPOINT SOURCE WATER AND SEDIMENT QUALITY DATA D-1

E SANTA CLARA TOXICITY DATA E-1

F USGS/SCVWD WATER AND SEDIMENT QUALITY DATA F-1

G POINT SOURCE LOADS G-1

H ANALYSIS OF UNCERTAINTY IN LOAD ESTIMATES H-1

APPENDIX A
FIELD MONITORING PROGRAM

APPENDIX A
FIELD MONITORING PROGRAM

A.1 INTRODUCTION

The field monitoring program was designed to provide data to characterize runoff concentrations and to estimate nonpoint source pollutant loads entering the Lower South Bay from Santa Clara County. Monitoring during storm events was conducted to provide data to calibrate and verify the hydrologic and pollutant simulation model. Hydrological and water quality data associated with base dry-weather streamflows were also collected to estimate dry-weather annual pollutant loads. A secondary objective was to obtain initial information on the toxicity of both storm-related and dry-weather flows in streams entering the Bay.

The field monitoring program utilized three types of stations, as follows:

- Land use stations - Small, relatively homogenous land use catchments were selected to represent major land use categories. Data from these catchments were used as input to the loading model.

- Stream stations - Stations that were located in the lower portions of watersheds and which received a composite of storm runoff waters from multiple land use categories. Stream stations were monitored to provide data to verify the loading model.

- Reservoir stations - Stations located immediately below the water supply reservoirs. These were utilized to provide data to establish upstream background water quality conditions and to estimate loads associated with reservoir releases.

The field program can be conveniently described in terms of the following elements:

- The hydrology monitoring element consisted of continuously monitoring flows at stream and land use stations at hourly intervals throughout the duration of the monitoring program in order to estimate the hydrological component of the load.

- Water quality monitoring was conducted in three program elements: wet weather, dry weather, and reservoir release. Wet-weather water quality monitoring consisted of monitoring water quality at land use and stream stations for seven storm events. Storm composite samples were collected. The purpose of this sampling was to provide a basis for estimating pollutant loads during winter storm events. In order to estimate loads during winter base flow periods and summer dry-weather periods, dry-weather water quality monitoring was conducted by obtaining grab samples at the stream stations eight times through the program. To provide information on the water quality of water released from reservoirs, one round of reservoir release water quality monitoring was conducted at six stations immediately downstream of reservoirs.

- Bottom sediment sampling was conducted at the four stream stations. This sampling was conducted quarterly throughout the first year of the study. The purpose of this monitoring was to evaluate the role of bottom sediments as both a source and sink of pollutants associated with nonpoint source runoff.

- The bioassay testing program was designed as an initial screening of toxicity exerted by wet-weather samples obtained from land use and stream stations and dry-weather samples from stream stations.

In addition to the above, a number of special studies were conducted to address specific concerns. These studies examined: (1) dissolved oxygen concentrations during storm events at selected stream stations, (2) dissolved metal concentrations in runoff, (3) settling rates of suspended particulates in stormwater collected from stream stations, and (4) concentrations of fecal streptococci bacteria in stormwaters.

A.2 SAMPLING STATIONS

The selection of appropriate sites for the field monitoring program was critical to characterize stormwater runoff pollutants. The following sections discuss the selection criteria and the characteristics of the selected catchments and stations.

A.2.1 Selection Criteria

Specific site selection criteria followed the general guidelines provided by Shelley (1979). Criteria used to select specific monitoring sites were (1) catchment characteristics, (2) hydraulic factors, and (3) accessibility and safety.

Catchment characteristics of primary concern in selection of land use stations were representativeness of land use, overall size of the catchment, and uniformity of land use. In practice, the latter two concerns tend to operate in an opposite fashion, thus constraining the suitability of many catchments for siting of monitoring stations. With increasing size of the catchment, it becomes more unlikely that the requirement for uniformity of land use can be met. In the case of stream stations, it was desirable that the stations be located as far downstream in the watershed as possible, yet upstream of any tidal influences that would adversely affect the rating curve.

Hydraulic factors were important considerations in selection of both land use and stream stations. In the case of open-channel stations, it was necessary that each be located at a site with an existing stage-discharge rating or at a site where adequate stage-discharge ratings could be established. Similarly, it was essential that manhole stations have suitable hydraulic characteristics for installation (and calibration) of the weirs. Thus, the following hydraulic factors were important considerations in the site selection process:

- Location at a site with an existing stage-discharge rating or at a site having a suitable control where a reliable rating curve could be developed
- Uniform and stable channel conditions for a distance equal to at least six channel widths upstream of the station
- Lack of tidal influence or backwater effects caused by downstream obstructions
- No evidence of surcharging or submergence over the normal range of precipitation (manhole installations)
- Adequate distance from major tributaries in order to allow for complete mixing

Safety and accessibility were important considerations, primarily to avoid accidents and injury, but also to ensure that field crews felt sufficiently safe so they exercised due care in conducting the field effort. Considerations included avoiding heavily trafficked areas or areas where light and/or visibility created conditions conducive to an accident with passing cars or trucks. Choice of station locations was also influenced by accessibility and security, and wherever possible, stations were located on SCVWD right-of-way which was secured.

A.2.2 Catchment and Station Characteristics

The following describes the catchment and station characteristics for land use and stream stations. For reference, Table A-1 summarizes general information and Table A-2 gives estimates of the land use mix of each catchment.

A.2.2.1 Land Use Catchments. The land use catchments were selected to represent the following major land use categories: light and heavy industry, commercial, single- and multi-family residential, and open.

Station L1 was a light industrial site located on Junction Avenue. The catchment drains a 22-acre industrial park bordered by Charcot Avenue, Dado Avenue, and Coyote Creek (in San Jose). The station was located in a manhole on Junction Avenue near the Southern Pacific Railroad (SPRR) lines. The storm drain diameter was 30 inches, and a sharp-crested weir was placed in the manhole to facilitate flow measurements. Truck traffic on Junction Avenue was often heavy and on one occasion was sufficient to create vibrations that broke the 10-liter glass bottle in the automatic sampler suspended below the manhole.

Station L2 was a heavy-industrial site on a catchment that drains Walsh Avenue between the SPRR lines and Lafayette Street (in Santa Clara). This 28-acre catchment included warehouse distribution centers involving heavy truck traffic, a used-car parts distributor, a commercial carpet cleaning service, a printing shop, and small miscellaneous manufacturing and office facilities. Initially there was an open drum storage area that was associated with a carpet cleaning facility; however, the drums were found to have been removed on a field reconnaissance conducted on December 5, 1988. The station was located in the right-of-way east of the SPRR lines in a manhole with a 20-inch-diameter storm drain. A weir was installed in the manhole for flow measurements. There was evidence of an illicit discharge at this station in August 1988 that was analyzed and shown to be strongly caustic.

Table A-1. STATION DESCRIPTION

Designation	Type of Station	Location	Location	Jurisdiction	Principal Land Use	Drainage Area (acres)	Conveyance	Remarks
L1	Land Use	Junction Avenue, between Charcot and Dado Streets	San Jose	San Jose	industrial park	22	30" R.C.P.	Manhole station, with weir installed
L2	Land Use	Walsh Avenue, near SPRR	Santa Clara	Santa Clara	heavy industry	28	27" R.C.P.	Manhole station, with weir installed
L3	Land Use	Frances and Beamer streets, north of Sunnyvale Caltrans RR Station	Sunnyvale	Sunnyvale	commercial	265	42" R.C.P.	Manhole station, with weir installed
L4	Land Use	Hale Creek, near Magdalena Rd.	Santa Clara County	SCVWD	low-density single-family residential (hillside)	1,633	open channel	SCVWD gaging station No. 33
L5	Land Use	Sunnyvale East Channel, near Fremont Avenue	Sunnyvale	SCVWD	single-family residential (valley)	2,080	channelized	Highly-erodable channel, rating developed
L6	Land Use	Pasetta and Williams, near San Tomas Expressway and SPRR	Santa Clara	Santa Clara	multi-family residential	85	33" R.C.P.	Manhole station, with weir installed

Table A-1. STATION DESCRIPTION (continued)

Designation	Type of Station	Location	Location	Jurisdiction	Principal Land Use	Drainage Area (acres)	Conveyance	Remarks
L7	Land Use	Stevens Creek, above Stevens Creek Reservoir	Santa Clara County	SCVWD	open (forest)	8,410	natural	Rating developed but not considered reliable because of backwater effects
L8	Land Use	Packwood Creek, at Jackson Ranch (east of Anderson Reservoir)	Santa Clara County	SCVWD	open (ranchland)	6,464	natural	SCVWD gaging station No. 57
S1	Stream	Calabazas Creek, at Wilcox School	Santa Clara	SCVWD	mixed	9,216	natural	SCVWD gaging station No. 26A
S2	Stream	Sunnyvale East Channel, at Bayshore Frontage Road (A.P. Sta 2)	Sunnyvale	SCVWD	mixed	3,437	channelized	SCVWD gaging station No. 74
S3	Stream	Guadalupe River, at San Jose	San Jose	SCVWD	mixed	15,904	natural	USGS gaging station No. 169000
S4	Stream	Coyote Creek, at Montague	San Jose	SCVWD	mixed	79,552	natural	SCVWD high-flow gaging station No. 2060
R1	Reservoir Release	Below Stevens Creek Reservoir (A.P. Sta 14)	Santa Clara County	SCVWD	open	10,924	natural	SCVWD gaging station No. 44

Table A-1. STATION DESCRIPTION (concluded)

Designation	Type of Station	Location	Location	Jurisdiction	Principal Land Use	Drainage Area (acres)	Conveyance	Remarks
R2	Reservoir Release	Below Lexington Reservoir	Santa Clara County	SCVWD	open	23,859	natural	SCVWD gaging station No. 67
R3	Reservoir Release	Below Guadalupe Reservoir	Santa Clara County	SCVWD	open	3,808	natural	SCVWD gaging station No. 17
R4	Reservoir Release	Below Almaden Reservoir	Santa Clara County	SCVWD	open	7,667	natural	SCVWD gaging station No. 16
R5	Reservoir Release	Below Calero Reservoir	Santa Clara County	SCVWD	open	4,621	natural	SCVWD gaging station No. 13
R6	Reservoir Release	Below Anderson Reservoir	Santa Clara County	SCVWD	open	124,787	natural	SCVWD gaging station No. 9

Table A-2. LAND USES (PERCENT) OF MONITORED CATCHMENTS[a]

Station		Area (Acres)	Open (%)	Residential[c] Low Density (%)	Residential[c] Medium Density (%)	Residential[c] High Density (%)	Commercial (%)	Industrial[d] Light (%)	Industrial[d] Heavy (%)	Other (%)	Remarks
L1	Junction Ave.	2						100			
L2	Walsh Ave.	28							100		
L3	Frances and Beamer	265			58		42				resid. density ~ 6-7 d.u./acre
L4	Hale Creek	1633	20	80							resid. density ~ 1-2 d.u./acre
L5	Sunnyvale East, at Fremont Ave.	2,080	6	49	30		21				
L6	Passetta and Williams	85			30	53				17	medium density resid. ~ 6-7 d.u./acre, other land use includes church (5 acres) and school (9 acres)
L7	Stevens Creek, at Camp Castanoan	8,410	100								
L8	Packwood Creek	6,464	100								
S1	Calabazas Creek	9,216[b]	21	35	36		7				
S2	Sunnyvale East at Bayshore	3,437[b]		47	18	3	32				
S3	Guadalupe River	55,904[b]	30	23	34	4	5	3	1		
S4	Coyote Creek	79,552[b]	64	4	24	2	1	4	1		

---

[a] Based on county and city general land use plans as compiled by SCVWD (projections generally ranged between 1989 and 2000), field reconnaissances, and aerial photos.

[b] Does not include areas above upland reservoirs.

[c] Definition of low-, medium-, and high-density residential differed amongst municipalities, but generally was as follows: Low--1 to 5 dwelling units/acre; Medium--6 to 12 dwelling units per acre; High--greater than 12 dwelling units per acre.

[d] Light-industrial land use refers to industrial parks and high technology manufacturing. Heavy industry refers to more traditional manufacturing and distribution centers.

Station L3 was a manhole station located at the intersection of Frances and Beamer Streets, north of the Sunnyvale Caltrans Station. The 300-acre catchment represented commercial and single-family residential land use and included the Sunnyvale Town Center and the Caltrans station. The drainage area was approximately bounded by the SPRR lines (north), Mathilde Avenue (west), Bayview Avenue (east), and Olive Avenue (south). A weir was also installed at this station.

Station L4 was located on Hale Creek near Magdalena Road. It drains a 1633-acre, low-density (1-2 dwelling units/acre), single-family residential area in Los Altos Hills. The station corresponded to SCVWD gaging station No. 33, which employs a sloping concrete weir as a hydraulic control for flow measurement.

Land use Station L5 was located on Sunnyvale East Channel at Fremont Avenue. It drains a 2080-acre predominantly single-family residential area. The monitoring station, located in a short earthen reach between Fremont Avenue and Ashbourne Drive, was just upstream of a concrete apron and box culvert which pass under Fremont Avenue. The channel was subject to extensive bank and bottom erosion, especially in the area downstream of the box culvert below Ashbourne Drive.

Station L6 was a 85-acre catchment consisting of a multi-family residential area bounded by Passetta, Williams, and Monroe streets, and Deborah Drive, and a single-family residential area located along Sheraton Drive and El Capitan Avenue. This catchment also included a church and school. The station was located in a manhole near the San Tomas Expressway and the SPRR. The second manhole upstream of the station was located at the junction of Passetta and Williams streets. The storm drain in the manhole was 33 inches in diameter. A weir was installed at this station to better estimate flows.

Station L7 was on Stevens Creek, just upstream of Camp Castanoan Bridge, above Stevens Creek Reservoir. The 8410-acre drainage area consisted primarily of steep, heavily forested land in the Santa Cruz Mountains.

Station L8 was a second open land use catchment (6464 acres in area) located in the Diablo Range and draining primarily open ranchland. The station corresponded to the SCVWD gaging station No. 57 on Packwood Creek, upstream of Anderson Reservoir.

A.2.2.2 Stream Stations. Four stream stations were selected at locations near the Bay, but above the zone of tidal influence. The purpose of the stream stations was to provide a means of making loading estimates from large catchments solely with measured flow and water quality data. Such estimates could then be used as a check by comparing findings with the model predictions (based on the upstream land use characteristics). The following is a description of the stream stations.

Station S1 was located at the SCVWD gaging station No. 26A, located on Calabazas Creek near Wilcox school. The drainage area is 14 square miles and consists of approximately 80 percent residential/commercial and 20 percent open (Table A-2), the latter of which is located mostly in the upland portions of the catchment in the foothills of the Santa Cruz Mountains. The control is a sloping concrete weir.

Station S2 was located on Sunnyvale East Channel, just upstream of Awhanee Avenue (a frontage road along Bayshore Freeway). This catchment has an area of 5.2 square miles and is wholly urbanized, consisting of residential (68 percent) and commercial (32 percent) land use on the valley floor. The station corresponds to the SCVWD gaging station No. 74. The control is a sloping concrete weir.

These two stations were selected to be representative of the smaller more urbanized watersheds on the west side of the Study Area.

Station S3 was the USGS station No. 1119000 on the Guadalupe River, located downstream of the confluence with Los Gatos Creek. This station has a total drainage area of 146 square miles and includes Los Gatos Creek and Lexington Reservoir, Guadalupe Creek and Guadalupe Reservoir, Ross Creek, Alamitos Creek and Almaden Reservoir, and Calero Creek and Calero Reservoir. This station was selected because it drains a large urbanized area that is accurately gaged. The area of the catchment below the reservoirs is approximately 85 square miles. The land use in this area is 30 percent open, 61 percent residential, 5 percent commercial, and 4 percent industrial (Table A-2).

Station S4 was located on Coyote Creek at Montague Expressway at the SCVWD high-flow gaging station No. 2060. This catchment includes Upper Penitencia and Silver and Thompson creeks, and Anderson and Coyote reservoirs. The catchment area below Anderson Reservoir is approximately 120 square miles, 64 percent of which is open ranch land located in the foothills of the Diablo Range. The remaining land use consists of 30 percent residential, 1 percent commercial, and 5 percent industrial (Table A-2). The SCVWD gaging station at this location was designed to record only flood stages, so this station had to be rated for more typical lower storm-event flows.

A.2.2.3 Reservoir Stations. The reservoir stations were located at SCVWD gaging stations below Stevens Creek, Lexington, Guadalupe, Almaden, Calero, and Anderson Reservoirs (Table A-1).

A.3 SAMPLING AND ANALYSIS PROGRAM

A.3.1 Hydrology

The field study was designed to collect accurate hydrological information at each station to quantify discharges throughout the year and to collect flow-weighted composite samples. Thus, monitoring of stage (water depth) was performed continuously throughout the year, at all stations that had year-round flow.

The majority of open-channel stations were located at sites which had previously-established stage-discharge curves. Two of the open-channel stations (L5 and L7) required establishment of new stage-discharge curves. A third station (S4) required establishment of the low-flow portion of the rating curve.

Flow ratings at all four manhole installations were initially calculated using a standard weir-rating formula. These ratings were later calibrated at manhole installations L2, L3, and L6 using dye-dilution methods.

A.3.2 Water Quality

Water quality constituents included in the field monitoring program were selected based on the following factors:

- Constituents previously identified to be a major concern in Lower South Bay and its tributaries

- Constituents previously identified as prevalent in urban runoff studies conducted as part of EPA's National Urban Runoff Program

- Pollutants expected to be present in surface runoff waters from the Study Area, based upon industrial sources, or other specific local knowledge

- Pollutants identified historically in nonpoint source runoff samples collected within the Study Area

The overall approach of the water quality studies was to examine a wide range (or "full suite") of potential pollutants in the early phases of the study and then develop a more refined list (or "reduced suite") of pollutants based upon results of the initial surveys (Table A-3). One analysis, organophosphate pesticides, was added to the reduced suite but was later eliminated, because none were detected.

A.3.3 Sediment Quality

The overall approach and list of sediment quality constituents (Table A-4) were similar to those described for the water quality testing program. The primary difference in the sediment quality program was that the reduced suite of constituents was originally expected to retain the broader scan of organic contaminants provided by the semi-volatile (EPA 625) GC/MS analysis. It was originally expected that a number of priority pollutant compounds would be detected in sediments, due to their low solubilities and their tendency to associate with fine particles. Due to low levels of these compounds detected, the final suite of constituents focused more directly on polynuclear aromatic hydrocarbons (PNA) that are produced as by-products of internal combustion engines.

Organophosphate pesticides were analyzed in the sediments on only one occasion. Since none were detected in the samples, this group of compounds was not included in later analyses.

A.4 SCHEDULE

The field monitoring program was initiated in February 1988 and completed in April 1989. Figure A-1 shows the schedule and Table A-5 gives specific sampling dates. A single survey was conducted to assess the quality of water discharged from six major reservoirs in the Santa Clara

Table A-3. SUITES FOR CHEMICAL ANALYSIS OF WATER QUALITY SAMPLES

Class	Complete Suite	Reduced Suite
Organics	Total Organic Halogens	Total Organic Halogens
	TOC	TOC
	Volatiles (624-GC/MS)	
	Semi-volatiles (625-GC/MS)	PNA (610)
(608)	Organochlorine pesticides (608)	Organochlorine pesticides (608)
	Chlorinated herbicides (8150)	
Metals, Total	Arsenic	Arsenic
	Cadmium	Cadmium
	Chromium (total)	Chromium (total)
		Chromium (hexavalent)
	Copper	Copper
	Lead	Lead
	Mercury	Mercury
	Nickel	Nickel
	Selenium	Selenium
	Silver	Silver
	Zinc	Zinc
Nutrients	TKN	TKN
	NH_3-N	
	NO_2 and NO_3	
	Total Phosphate	
Bacteria	Total and fecal coliform	Total and fecal coliform
Other	BOD_5	BOD_5
	Temperature	Temperature
	pH	pH
	TSS	TSS
		Total hardness
		Turbidity

Table A-4. SUITES FOR CHEMICAL ANALYSIS OF SEDIMENT QUALITY SAMPLES

Class	Complete Suite	Reduced Suite
Organics	TOC	
	Volatiles (8240-GC/MS)	
	Semi-volatiles	PNA (8310) (8270-GC/MS)
	Organochlorine pesticides (8080)	Organochlorine pesticides (8080)
	Chlorinated herbicides (8150)	
Metals, Total	Arsenic	Arsenic
	Cadmium	Cadmium
	Chromium (total)	Chromium (total)
		Chromium (hexavalent)
	Copper	Copper
	Lead	Lead
	Mercury	Mercury
	Nickel	Nickel
	Selenium	Selenium
	Silver	Silver
	Zinc	Zinc
Nutrients	TKN	
	NH_3-N	
Other		Sediment particle size

PROGRAM ELEMENT	1988												1989						
	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J
1. Reservoir Water Quality		(1) ●																	
2. Dry-Weather Water Quality		(1) ●	(2) ●		(3) ●			(4) ●				(5) ●		(6) ●		(7) ●			
3. Wet-Weather Water Quality				(1) ●							(2) ●		(3) ●	(4,5) ● ●	(6,7) ● ●				
4. Wet-Weather Toxicity														(1) ●	(2,3) ● ●				
5. Dry-Weather Toxicity												(1) ●		(2) ●		(3) ●			
6. Sediment Sampling			(1) ●		(2) ●			(3) ●				(4) ●							
7. Dissolved Oxygen														(1) ●					
8. Dissolved Metals															(1,2) ● ●				
9. Settling Column Tests															(1) ●				
10. Fecal Streptococci													(1) ●						

Figure A-1. SAMPLING SCHEDULE

Table A-5. SAMPLING DATES

Program Element		Round	Sampling Date[a] Month	Day	Year
(1)	Reservoir Water Quality	1	February	26	1988
(2)	Dry-Weather Water Quality	1	February	26	1988
		2	March	30	1988
		3	May	11	1988
		4	August	22	1988
		5	December	12	1988
		6	February	1	1989
		7	April	6	1989
(3)	Wet-Weather Water Quality	1	April	20	1988
		2	November	23	1988
		3	January	23	1989
		4	February	4	1989
		5	February	9	1989
		6	March	2	1989
		7	March	25	1989
(4)	Wet-Weather Toxicity	1	February	9	1989
		2	March	2	1989
		3	March	25	1989
(5)	Dry-Weather Toxicity	1	December	12	1988
		2	February	1	1989
		3	April	6	1989
(6)	Sediment Sampling	1	March	30	1988
		2	May	11	1988
		3	August	22	1988
		4	December	12	1988
(7)	Dissolved Oxygen	1	February	9	1989
(8)	Dissolved Metals	1	March	25	1989
		2	April	6	1989
(9)	Settling Column Tests	1	March	25	1989
(10)	Fecal Streptococci Bacteria	1	January	23	1989

[a] Initial date only; sampling often continued for one or two additional days.

Valley. The reservoir water quality survey was conducted on February 26, 1988, concurrently with the first dry-weather water quality survey.

A total of seven dry-weather water quality surveys were conducted during the 15-month field program. Four of these studies were conducted during winter months, two during the spring, and one in the autumn following a lengthy dry period.

Seven wet-weather (i.e., storm) events were sampled to obtain water quality data. The first and only storm event sampled in the 1987-88 wet-weather season occurred on April 20, 1988. The six remaining storm events that were sampled occurred in the 1988-89 wet-weather season. The first significant rainfall of the 1988-89 wet-weather season was sampled on November 23, 1988. The remaining five storm events monitored were in January, February, and March 1989.

Three wet-weather toxicity tests were conducted in February and March 1989. Dry-weather toxicity testing was coordinated with the December 12, 1988, and the February 1 and April 6, 1989, dry-weather water quality surveys.

The sediment sampling was fully completed during the first year of the study. The final quarterly sediment survey was completed on December 12, 1988.

A number of other program elements classified as "special studies" were completed in association with storm events sampled in early 1989. Detailed monitoring of dissolved-oxygen levels was performed at the four stream stations on February 9. Concentrations of dissolved metals were added to the suite of constituents measured in storm runoff during the March 25 and April 6 storm events. Experiments on settling rates of suspended particulates were conducted on samples collected on May 25. A special survey of concentrations of fecal streptococci bacteria was conducted in association with the January 23 storm event.

A.5 EQUIPMENT

A.5.1 Station Design

Two generalized station designs were employed in the field study. The most common design was for monitoring flow and water quality in open channels. This configuration varied slightly among the several stations, depending upon specific site characteristics. The second type of station was designed for monitoring flow and water quality within storm sewers.

The following design considerations were common to both station configurations:

- Intakes must be protected from large objects transported by the stormwater runoff.
- Intakes must be located in a well mixed area not subject to burial or emergence.
- Water velocity in the intake hose during sampling must be maximized to maintain particulate material in suspension.
- Intake hose material must be appropriate to avoid metals and organic contamination of samples.
- Sample container material must be compatible with holding samples to be analyzed for both trace metals and organic compounds.
- The peristaltic pumps must be capable of delivering consistent sample volumes, regardless of intake hose length and changes in head associated with the rise and fall of stage in the water body being sampled.

- Automatic samplers should not exceed a head difference of 20 feet above the water in order to prevent deterioration in water velocities within the intake and decreasing precision in sample volume.

All intakes were placed in cages constructed of quarter-inch stainless rod. These cages were designed to deflect moderate-sized objects around the intakes and the pressure sensors. Coarse stainless steel intake screens were used to reduce the likelihood of blockage within the sample tubing.

In most installations, intakes were positioned between 2 and 4 inches above the bottom, as recommended by Shelley (1979). This range was believed to be a reasonable compromise between avoidance of bedload transport and keeping the intake submerged. When base flow conditions allowed, the intake was positioned higher in the water column. For example, the base stage in Coyote Creek was typically around 3 feet, so the intake at this station was positioned 1.5 feet off the bottom.

The 3/8-inch (i.d.) intake hose was constructed of polyethylene on the outside and Teflon on the inside. The polyethylene provided the required physical strength while the Teflon provided a suitable material for handling samples which would be analyzed for either metals or organic compounds. The bore diameter of the intake hose was selected to maximize the velocity of flow within the hose (in order to prevent settling of suspended solids). An internal diameter of 3/8 inch was calculated to maintain the minimum velocities of 1 to 2 fps at head differences of up to 20 feet.

Consistent sample volumes were obtained over a wide range of head differences by development and use of an algorithm which could compensate for changes in head pressures. This algorithm was part of the specialized software developed to control the automatic samplers. The number of pump rotations necessary to obtain a sample volume of 500 ml was calculated as a function of intake hose length and an instantaneous measure of head pressure between the pump and surface of the water. This value could be calibrated in the field to compensate for specific station configurations.

The composite sample containers provided commercially by ISCO were inappropriate for collection of water for analysis of both trace metals and organic compounds. Borosilicate glass provided the best alternative for collection of water to be submitted for metals and organics. Thus 10-liter, borosilicate media bottles were used to replace the standard containers.

Although the open-channel and manhole installations shared common design criteria, the manhole installations were unique in that they required installation of a primary control device to increase accuracy of flow measurements, particularly at lower flows. Rectangular sharp-crested weirs were used, because they were found to be the most cost-effective primary control device to fabricate and install in this application.

A.5.2 Weirs

All weirs utilized in the manhole installations were rectangular weirs made from quarter-inch steel plate. The heights of the weirs were generally about one-half the diameter of each pipe. A rectangular cutout with a width equal to one-quarter of the pipe diameter and a depth equal to one-sixth of the diameter was placed in the center top portion of the weir to facilitate accurate measurement of lower flows (see Figure A-2).

Each weir was secured by stainless steel cable to eyebolts set in the wall of the manhole. This both prevented the weirs from becoming lodged in the pipe if they were to break loose during a storm event, and it allowed for quick removal of the weirs, if upstream flooding were to occur. Hoses were attached to the back of the weirs to aerate the nappe.

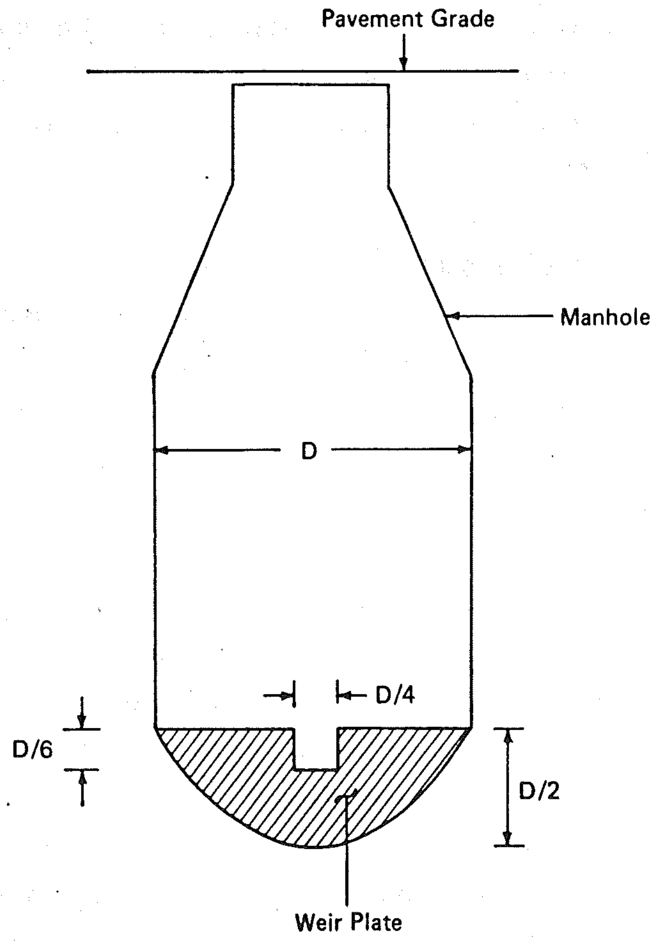


Figure A-2. WEIR SCHEMATIC

A.5.3 Automatic Samplers and Stage Recorders

Automatic samplers and stage recorders were deployed in all of the open-channel and manhole installations. Each system consisted of an ISCO Model 2700 composite sampler, a Campbell Scientific Model CR-10 Data Logger and Control Module, and a pressure sensor. GeoKon Model AVW-1 Vibrating Wire pressure/temperature sensors were initially installed at all stations. These sensors were selected for the study on the basis of their extreme durability and accuracy. Nevertheless, a number of these sensors were observed to drift out of specifications in the early stages of the study. These sensors were then replaced with the newly available Druck Model PDCR-830 titanium pressure sensors. These Druck sensors proved to have both excellent accuracy and stability characteristics under a variety of field conditions.

The ISCO composite samplers were used to pump, cool, and store water samples during storm events. The standard programmable read-only memory (PROM) units which contain the instruction set for the samplers were specially modified to allow full external control via the sampler's flowmeter input data port. All pumping functions could then be controlled externally by the Campbell Scientific CR-10.

A.5.4 Data Logger

Campbell Scientific CR-10s were used at each station to provide overall system control functions and to serve as a central data processor and data storage module. Two types of data, high-resolution storm data and continuous (dry- and wet-weather) hydrology data, were recorded by the data logger. Data were nondestructively retrieved by use of a standard, portable tape deck. The tapes were then read by an IBM-compatible microcomputer with a Campbell Scientific PC-201 card. If the data dump was defective, the station could be revisited and the data retrieved again.

The storm data memory register stored detailed information on the storm events, including the time the storm mode was initiated, the time each sample was taken, and the storm runoff volume represented by each sample. After completely filling a 10-liter sample container, 15-minute-averaged values for temperature, stage, and flow were stored in the storm memory register until the station was visited by the field crews to change sample containers.

The continuous hydrology memory register maintained hourly-averaged temperature and stage data. These data were continuously recorded during storm events and base flow conditions.

A.5.5 Software to Initiate and Terminate Flow Composite Sampling

Software installed in each CR-10 was designed to continuously monitor stage at each monitoring station and then automatically initiate flow-weighted composite sampling. Pressure sensors were interrogated every 15 seconds to determine stage. Fifteen-minute averages of the stage data were then stored and later used to evaluate whether storm sampling should be initiated.

The software enabled storm sampling to be initiated, based upon both relative and absolute criteria. At the end of every 15-minute interval, stage or flow data (using stage-discharge equations) were compared to those obtained during the prior 15-minute interval. Storm sampling was initiated, if percentage increases in one of these parameters exceeded a given criterion, typically 20 percent. This criterion could be modified to adjust sensitivity of the "trigger," based upon the specific hydrological characteristics of each station.

In addition to comparing relative increases in either stage or flow, storm sampling could be automatically initiated if the 15-minute average stage measurement exceeded a set value. This trigger was particularly useful for stations that, under certain conditions, did not increase rapidly enough in stage to exceed the relative criteria or where no base flows were present.

Flow-weighted composite sampling could also be terminated by software control of the system. The data loggers were programmed to terminate the storm sampling mode once the stage dropped below a level 20 percent greater than the storm initiation or trigger stage. Sampling would not terminate automatically without first filling a sample container.

A.5.6 Equipment and Installation

Instrumentation for all open channel installations was contained in custom-built 2-ft x 4-ft x 30-inch steel enclosures mounted on concrete pads. In natural channels, conduits for containment of pressure sensor leads and water intake tubing were installed through the concrete pad and led underground to the channel. In some cases, a short conduit (approximately 0.5 to 1.0 feet) was installed between the instrument enclosure and adjacent stilling wells. The pressure sensor could then be installed in the stilling well where it was well protected from potential vandalism. For installations where both stilling wells and concrete channels existed, both the pressure transducer and intake hose were run into the stilling well. The intake tubing was then fished through the lower communication port and mounted at the bottom of the channel.

Each storm sewer installation was completely contained within the existing manhole chambers. All equipment was suspended by metal cable slings from eyebolts installed in the concrete wall just under the manhole cover. A two-person field crew was required to conduct routine monitoring involving removal of the sampling equipment from the manhole. Data dumps and routine monitoring of station operation could be performed by one person, since the systems communication port was located immediately below the manhole cover.

A.6 SAMPLING METHODS

A.6.1 Field Procedures and Training

A detailed set of Standard Operating Procedures (SOP) were developed for all phases of the field monitoring program. The SOP contained the following procedural instructions:

- Standard Observations
- Initial setup of the composite samplers
- Storm monitoring station software initiation
- Battery replacement
- Data retrieval
- Sample removal and handling
- Grab sampling
- Sample transfer and tracking

Field training sessions were held prior to each storm season for personnel expected to participate in storm monitoring. The training sessions involved review of the SOP and hands-on experience in interrogating a model storm monitoring station.

Additional training was provided in the field during station maintenance visits. Less experienced field personnel were routinely deployed with key project personnel. This enabled greater dissemination of important station-specific knowledge (e.g., location and special handling needs) and provided an opportunity to practice station interrogation skills that would be needed during the intensive storm monitoring events.

A.6.2 Grab Samples

Grab samples were taken for all water samples that were not appropriate for analysis from the pumped composite sample. Grab samples were necessary for bacteria, volatile organics, pH, and dissolved oxygen.

Two methods were used to obtain grab samples of water. The primary method involved direct collection of the water sample in the sample container. The open container was attached to a stainless steel rod. This enabled the open container to be fully immersed as near as possible to the centroid of flow and eliminated potential contamination of the sample. This method was applied to samples collected for bacteria, volatile organics, and pH. Van Dorn (1.5-liter) bottle samplers were used for collection of samples for measurement of dissolved oxygen.

The guidelines followed by Kinnetic Laboratories field personnel for grab sampling during storm events calls for collection of samples in the early phase of the storm, certainly during the rising limb of the hydrograph. Most of the grab samples collected in this program were performed in the early phase of the storm.

Sediment grab samples were collected either by use of clean stainless steel scoops or by scraping the sediments directly into the sample containers. Four to five different scrapes were taken to comprise a single sample. A conscious effort was made to sample finer-grained sediments in depositional areas of the stream bed. In several cases, appropriate sediments were difficult to locate. In such cases, professional judgement was used to locate the most appropriate sediments along a given reach.

A.6.3 Automatic Samplers

Sampling of stormwater runoff was accomplished primarily by use of modified ISCO composite samplers. The automatic samplers were designed to take 500-ml aliquots of runoff water at time intervals corresponding to a given volume of water flowing by the monitoring station. The volume of runoff represented by each 500-ml sample was a user-specified value. The default setting for each site was 1/20 of the expected runoff volume for a 0.25-inch storm. The sampling rate at a given station could be altered in the field by increasing or decreasing this value. It was necessary to adjust this variable based upon both sample volume requirements (e.g., additional analytical and bioassay water requirements) and anticipated rainfall in excess of 0.25 inches.

The percentage of the total storm represented by each composite sample varied widely among storm events and stations (Table A-6). The precipitation, runoff, and required sample volumes were important factors in determining the percentage of the storm from which flow-weighted composites were attained. After depositing 19 samples (9.5 liters) into the composite sample container, the monitoring system would go into standby mode until visited by the field crew. High sampling rates or brief, intense periods of rainfall occasionally caused the composite samplers to fill too rapidly and enter the standby mode. This would cause loss of storm coverage until the station was revisited by the field crew. Low sampling rates or lower than anticipated rainfall would result in good storm coverage but inadequate sample volumes.

A.6.4 Effects of Partial Storm Capture on Load Estimates

In the field monitoring efforts, it was not always possible to secure samples over the entire runoff period, for use in the flow-weighted composites that were analyzed. In some cases, this was due to the inability of field crews to reach all stations before runoff began. In most cases, it resulted from the sample collection container filling before runoff from the event had terminated. A record was maintained of the fraction of the total runoff volume that was sampled and incorporated in the samples for water quality analysis. This information is summarized in Table A-6 which lists, for each event at each station, the ratio of the sampled volume to the total volume of runoff.

As the listing indicates, the storm fraction sampled varied from event to event at any site, and the pattern was not consistent from site to site for a specific storm event. Fifty-seven (57) of a possible 70 station-events produced composite samples that were analyzed for water quality. Four station-events were missed due to equipment malfunction (SM). The

Table A-6. PERCENT OF STORM EVENT RUNOFF SAMPLED[a]

		Stations[b]									
Event No.	Date of Storm Event	L1	L2	L3	L4	L5	L6	S1	S2	S3	S4
1	4-20-88	21	95	98	NS	SM	33	SM	40	57	100
2	11-23-88	100	90	97	NS	75	95	17	33	61	50
3	1-23-89	NS	NS	NS	NS	73	NS	3[c]	50	57	NS
4	2-1-89	35	3[c]	85	70	73	SM	40*	29*	66	40
5	2-8-89	33	56	100	100	58	36	40	53	46*	63
6	3-2-89	32	79	100	50	100	100	51	99	65	74
7	3-23-89	NS	NS	78	60	100	95	36	50	SM	67

---

[a] The ratio of the volume sampled to the total volume of runoff is the percentage of the runoff sampled.

[b] Samples were not obtained at Station L8 because of lack of runoff; samples were obtained at Station L7, but the rating curve was affected by downstream activities.

[c] The percent sampled was considered too small for the data to be considered representative.

NS Not sampled (often because of lack of runoff).

SM Sampling equipment malfunctioned.

* Volume sampled did not include the storm peak.

remaining nine (NS) produced no water quality samples, often due to lack of runoff.

An evaluation of the potential effect of the percentage of an event sampled on the estimate of the site median concentration (SMC) which was used in developing pollutant load estimates was structured on the basis of the following considerations.

- The data set as a whole covers a wide range of sampled fractions, and a significant spread in percent sampled also applies generally to individual stations.
- The quality data exhibit significant variability, with each station having a different mean or median.
- Concentrations of different pollutants have different orders of magnitude.
- Working separately with individual pollutants at individual sites provides too small a sample for reliable analysis.

To evaluate the effect of the fraction of the storm sampled, each EMC (event mean concentration for the site-event for each pollutant) was first normalized by computing the ratio of the individual concentration value to the SMC for the corresponding pollutant and site. Individual EMCs are tabulated in the Volume I Appendix document. The SMC values used are those presented in report Tables 6-2 and 6-3. Pollutants used in this analysis were those for which nearly all measurements were above detection limits. This set included six metals (Cd, Cr, Cu, Pb, Ni and Zn), plus TSS, BOD and Total Hardness (TH), to have several different basic pollutant types represented. The normalization procedure reduced all the data to a common basis, and provides a sample size of about 500 values for analysis.

A comparison of the normalized pollutant concentrations in relation to the percentage of the storm event that was sampled is displayed by Figure A-3 for the Land Use Sites, and by Figure A-4 for the Stream Stations.

Pollutant concentrations for the Land Use Sites provided the primary basis for the load estimates. A good basis for comparison exists here, because 42 percent of the site-events captured 90 to 100 percent of the runoff (65 percent captured more than 70 percent). The display indicates that the variability in measured concentrations of the nine different pollutants is unrelated to the fraction of total runoff volume captured. There are a small number of individual values that deviate substantially from the median, but the bulk of the results (all pollutants, all sites, all percent captures) fall into a relatively narrow band either side of the site median (Ratio = 1). Note that each SMC reflects a series of events with an appreciable range of percent captures.

On this basis, we conclude that the pollutant site median concentrations, which provided the principal basis for load estimates, are not distorted by the lower percentages of total runoff that were sampled for some events. This situation, therefore, has not influenced the load estimates that were developed.

Results for the Stream Stations are generally similar, but with the difference that less than 10 percent of the values apply to events where more than 90 percent of the runoff was captured. For these stations, 85 percent of the values apply to events which captured between 30 and 70 percent of the storm flow. There is no trend indicated either within this range, or compared with the limited data at 100 percent runoff capture. The single set at 3 percent capture (event 3 at station S-1) would be appropriate to exclude, although this single set of values will not have a significant effect on the overall study results.

Fig. A-3. Effect of Percentage of Total Storm Sampled
on Event Mean Concentration
Land Use Sites

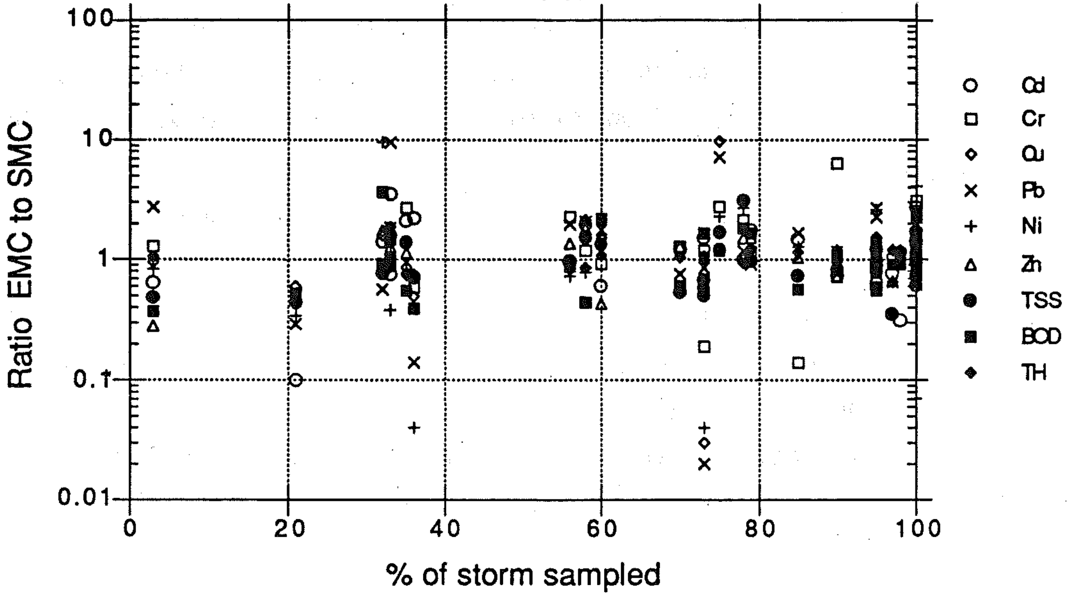
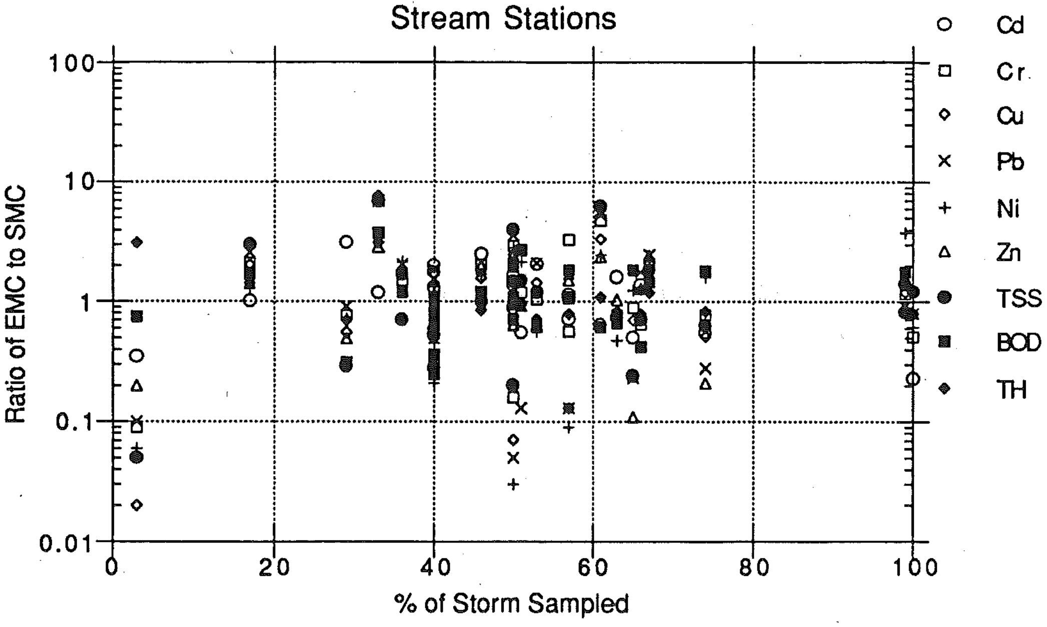


Fig. A-4. Effect of Percentage of Storm Sampled
on Event Mean Concentration
Stream Stations



The stream concentrations were utilized in the study for comparison with projected in-stream concentrations computed from the land use runoff. The differences (measured concentrations were consistently greater than projections based on land runoff) provided the basis for a correction factor. The variation in percent capture of event runoff is not indicated to influence estimates of stream concentrations. However, because the bulk of this data is based on 30 to 70 percent capture of the total event values, there is a somewhat greater uncertainty in the concentration estimates for the Stream Stations, than is the case for the Land Use Sites.

A.6.5 Flow-Rating

Development of new stage-discharge relationships was required at three open channel stations and three manhole stations. In manhole stations, rectangular notched weirs were installed. Flow was then estimated based on the theoretical sharp-crested contracted weir equation (ISCO 1979):

$$Q = 3.33\ (L - 0.2H)H^{1.5}$$

where

Q = flow (cfs)
L = width of the weir crest (ft)
H = stage (feet)

This equation was verified by performing low-flow dye dilution measurements at the manhole stations. These tests indicated that some calibration of the weir equation was required for flow within the weir notch at stations L2 and L3. As a result, the following rating curves were used for low flows in these weirs:

$$Q = 1.73H^{.85} \text{ (Station L2)}$$
$$Q = 1.83H^{1.79} \text{ (Station L3)}$$

Rating curves for stations L5, L7, and S4 were developed from discharge measurements. Rating curves were developed only for low flows at station S4, since a high flow rating curve had previously been developed by the SCVWD. Figures A-5, A-6, and A-7 show the rating curves for these three stations. Discharge measurements for these stations were generally good. For station S4, the rating curve was developed from 10 flow measurements, and a good fit was obtained to these data. However, the rating curves for stations L5 and L7 are at best of fair quality, given the low number (three) of discharge measurements used at each station.

Current-meter surveys were conducted to develop stage-discharge data at the three open-channel stations. Discharge methods were made using standard USGS methods (USGS 1970). It was desired that at least six discharge measurements be taken over a full range of stages in order to obtain reliable rating information at each site.

Dye-dilution methods were used to verify weir equations at three of the four manhole stations. (At these stations, provisions for a water supply could be arranged with the local water supplier.) Intra-acid Rhodamine WT was used as the tracer. Rhodamine WT is a nontoxic, fluorescent tracer dye that is commonly used in applications such as this. This dye is stable and is not easily adsorbed to particulates.

Flow was established at each station by use of upstream fire hydrants. Dye of a known concentration was injected into the turbulent flow at an upstream manhole by use of FMI constant displacement piston pumps. Stage, temperature, and dye concentration were then measured just upstream of the weir at the subject station. Periodic water samples were obtained for later laboratory verification of dye concentrations in order to provide backup to the field fluorometer and to make certain that concentrations were in the linear response range of the fluorometer. Due to the limited flow capacity of fire hydrants, verification of the theoretical weir equations was only possible for low-flow conditions.

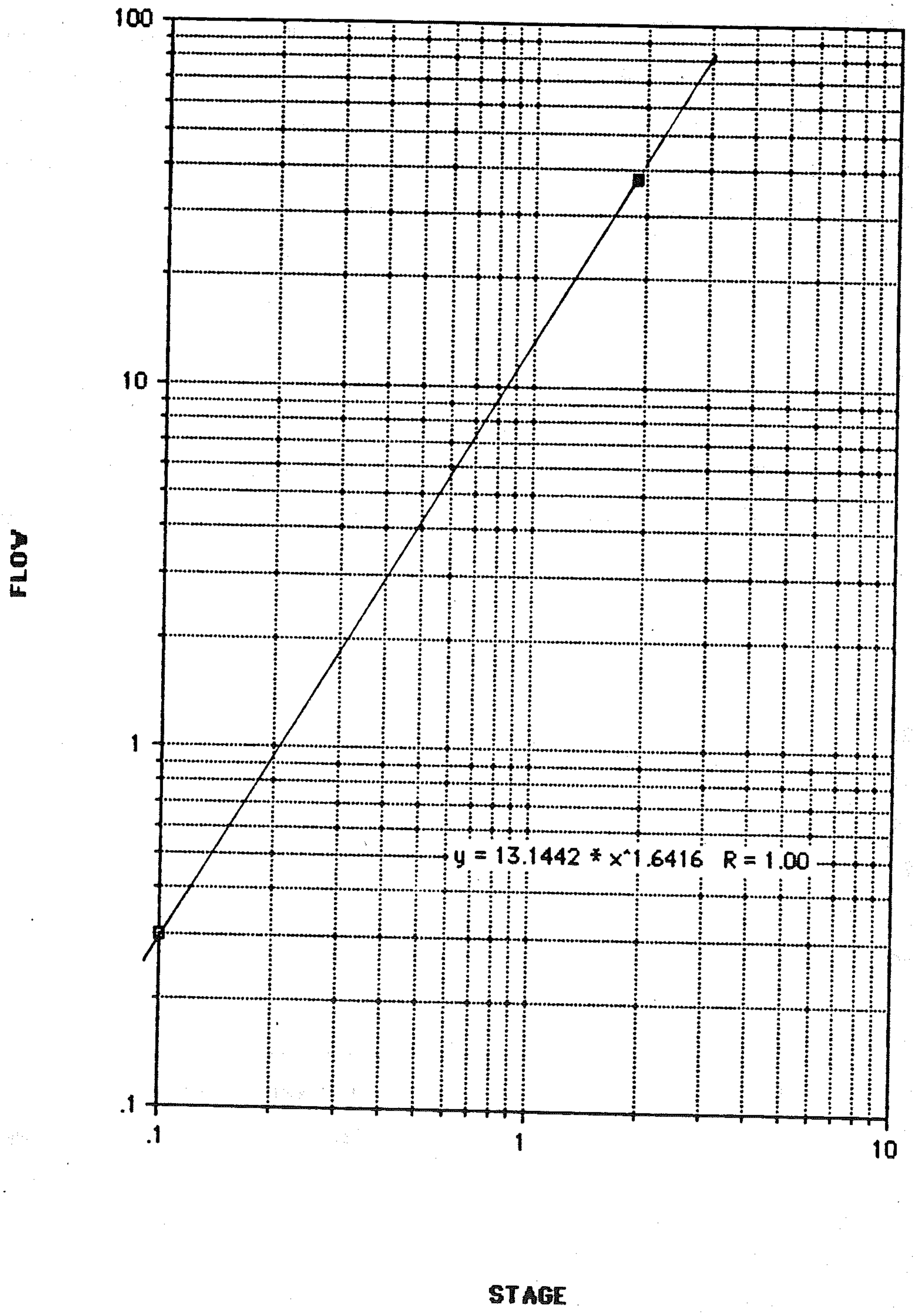


Figure A-5. Rating Curve for Station L5

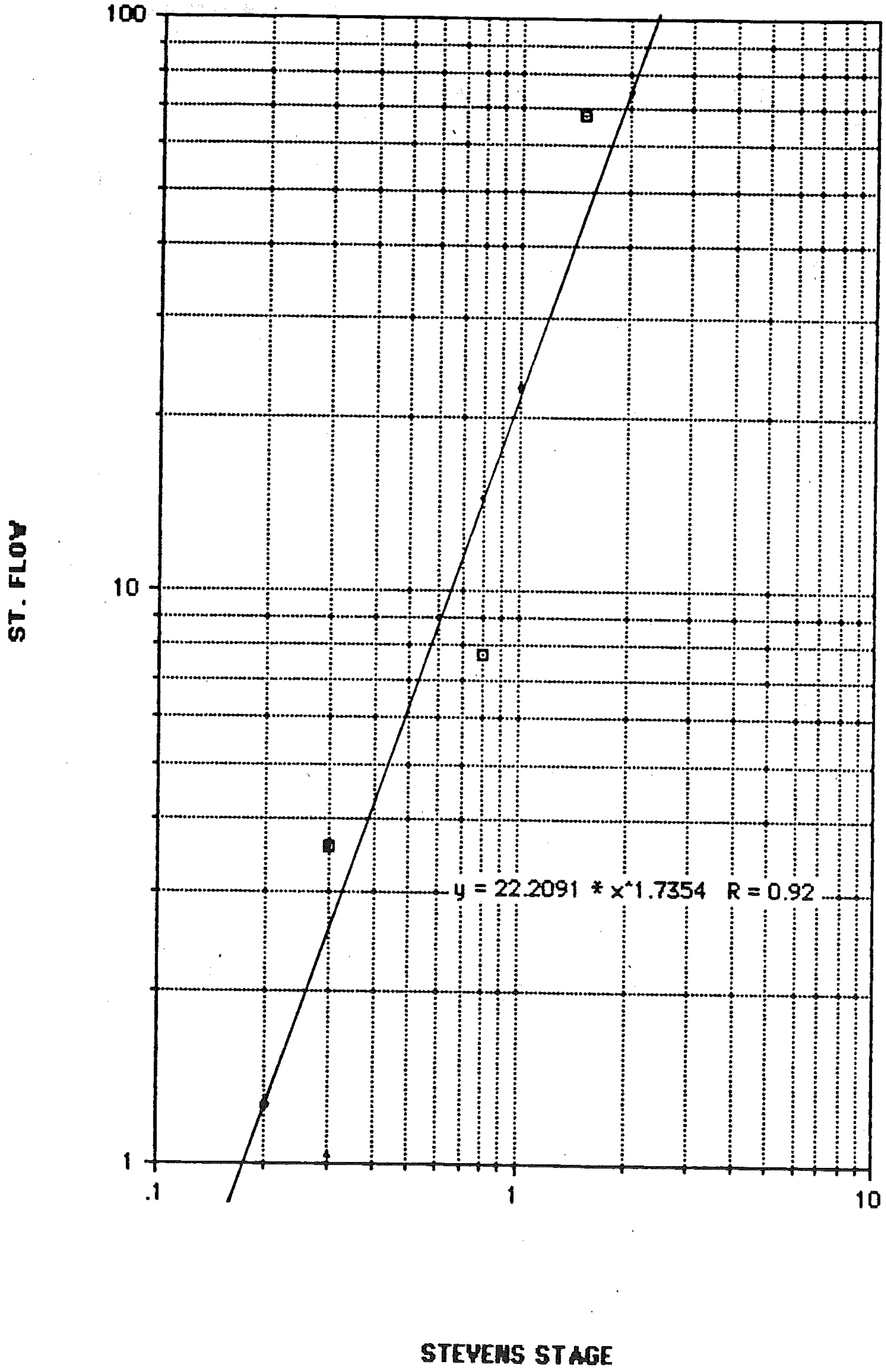
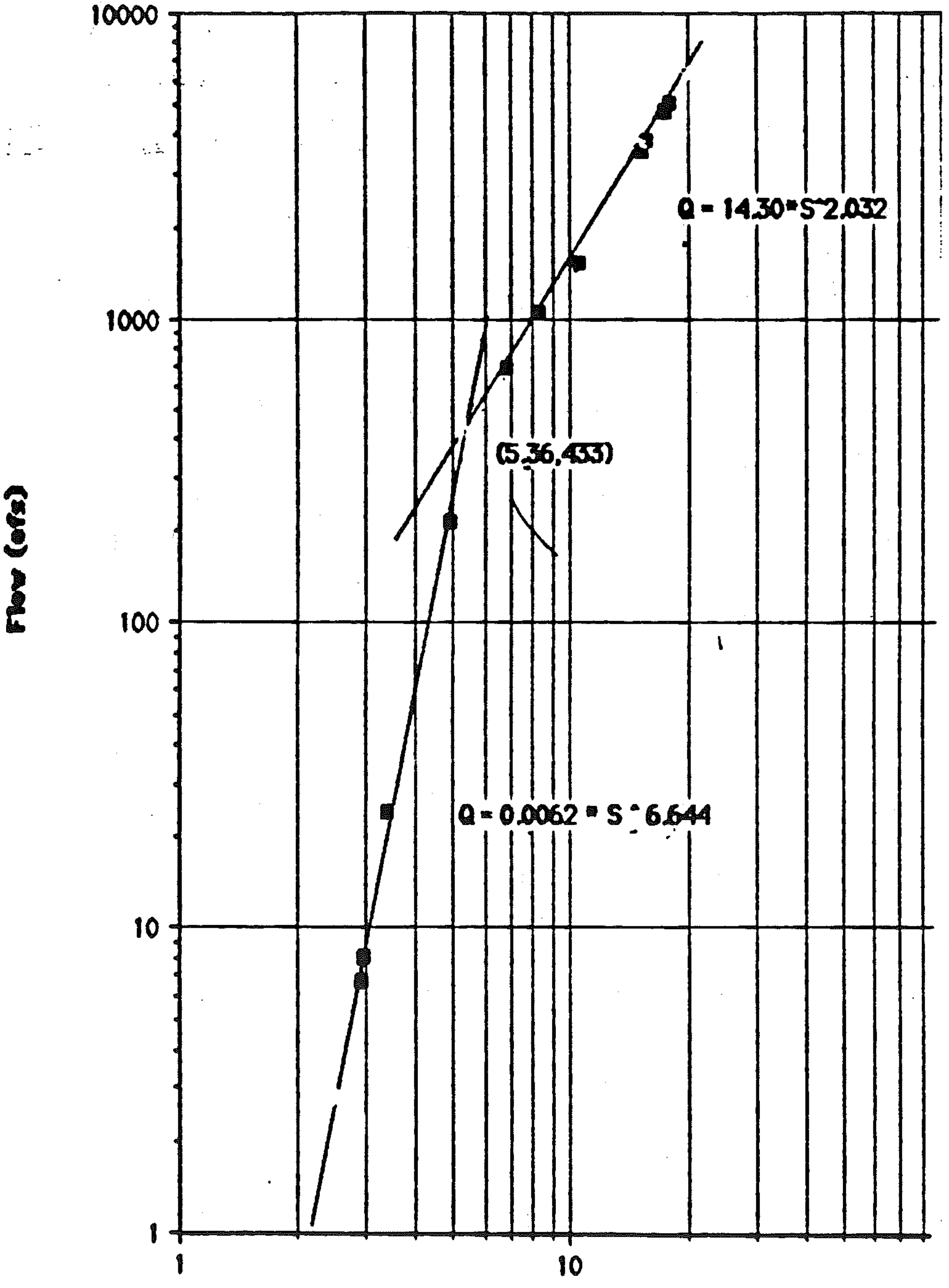


Figure A-6. Rating Curve for Station L7



STAGE

Figure A-7. Rating Curve for Station S4

A modification of the channel occurred at one station, L7 (Stevens Creek at Camp Castanoan Bridge), midway through the study. That alteration required establishment of a second rating curve. A small rock dam was constructed just below the station in order to enhance the water supply system for Camp Castanoan. This dam was breached during a storm in early March, at which time the initial flow rating was reinstated.

A.6.6 Special Studies - Dissolved Oxygen

Many of the previous studies involving nonpoint source water quality have been concerned about depression of dissolved oxygen levels in the receiving waters. A single intensive study was conducted at each of the four stream stations to measure dissolved oxygen concentrations during and after stormwater discharges.

Dissolved oxygen was measured for a period of approximately 35 hours using duplicate Winkler titrations in lieu of polarographic membrane probe techniques. The titrations provide a much more accurate estimate of dissolved oxygen, particularly in the presence of oil and grease. Polarographic oxygen probes can become rapidly desensitized if contaminated with oil and grease.

Dissolved oxygen results did not show any signs of depression for all four stations studied. The DO results are summarized here and shown in Appendix D.8. For station S-1, DO ranged from 8.9 to 11.8 mg/L, and DO levels ranged from 8.6 to 12.2 for station S-2. The DO concentrations were similar for stations S-3 (9.7 to 10.4 mg/L) and S-4 (8.5 to 9.6 mg/L).

A.6.7 Special Studies - Dissolved Metals

Two sampling rounds were conducted to evaluate the relative contributions of dissolved metals and particulate-associated metals in stormwater runoff. Both dissolved and total metal concentrations were measured in all stormwater samples obtained during each storm event.

Dissolved metal samples were subsampled from the composite storm samples in the same manner as the total metal samples. Prior to fixation, the dissolved metal samples were filtered through 0.45-micron polycarbonate filters. The filtrate was subsequently acidified with HNO_3 to a pH of less than 2.

A.6.8 Special Studies - Settling Column Tests

A preliminary screening of the settling characteristics of particulates present in the NPS discharges from the study area was made by conducting settling tests on samples taken from each of the stream stations (S-1, S-2, S-3, and S-4) during the storm runoff event in March 1989.

This effort was designed to provide information on settleability, for reference and potential use in the consideration of issues such as detention basin controls, sediment accumulation and scour in stream beds, and pollutant accumulations in bay sediments.

Because of the nature of the test procedure and the variability expected of particle size distributions in stormwater runoff, the results obtained should only be considered to provide a general approximation of the settling characteristics of particulates that are introduced to the South San Francisco Bay by nonpoint sources in the study area.

The tests were performed using a settling column constructed from an 8-inch in diameter by 5-foot, 1-inch-long lucite tube. Four sample ports are located at 1-foot intervals.

The column is filled to the top with a sample of the water to be tested, and then stirred to distribute the settleable solids uniformly throughout the column.

A sample at time zero is analyzed to establish initial conditions. Total suspended solids (TSS) was selected as the pollutant analyzed for these tests.

Samples are then withdrawn from each port at selected time intervals after the start of the test. They are analyzed to determine the concentration of TSS that remains at the sample location after the elapsed time interval.

The difference between each such concentration and the amount present initially is used to compute a percent removal.

Since each combination of depth to a sample port and elapsed time to the sample reflects a specific distance settled in a specific interval of time, each sample corresponds to a settling velocity (feet per hour). Each such value corresponds to a percent removed value computed from the measured concentration.

The results can be interpreted as the percentage of the TSS in the sample that have settling velocities equal to or greater than the value represented by the port depth and sample time. The results are then plotted to provide an indication of the frequency distribution of pollutant settling velocities in the sample.

Test results are summarized in Table A-7. This table lists both the measured concentration and also the percentage of the initial concentration that each value represents. It also lists the set of settling velocities (in feet per hour) that are computed from the various combinations of depth and sample time. Note that the combinations employed result in multiple measurements for some settling velocities. In the table, the settling velocities are listed in increasing rank order, and for each of these the corresponding removal percentage is tabulated for each of the four samples.

Table A-7. Settling Column Test Results

STA		MEASURED TSS CONCENTRATIONS						settling time <--hours--> settling distance feet	PERCENT TSS REMOVED				
		sample port	2	6	12	24	48		2	6	12	24	48
S-1	85	mg/l = initial TSS											
		1	53	34	25	8	14	1	38	60	71	91	84
		2	59	40	30	13	9	2	31	53	65	85	89
		3	63	39	23	13	10	3	26	54	73	85	88
		4	76	43	26	25	23	4	11	49	69	71	73
S-2	28	mg/l = initial TSS						sett dist FT					
		1	12	9	14	9	10	1	57	68	50	68	64
		2	15	16	19	9	8	2	46	43	32	68	71
		3	30	24	14	5	13	3	-7	14	50	82	54
		4	31	22	17	12	3	4	-11	21	39	57	89
S-3	22	mg/l = initial TSS											
		1	19	5	8	12	12	1	14	77	64	45	45
		2	24	9	9	5	4	2	-9	59	59	77	82
		3	17	15	18	9	5	3	23	32	18	59	77
		4	19	17	9	7	3	4	14	23	59	68	86
S-4	69	mg/l = initial TSS											
		1	58	43	32	28	10	1	16	38	54	59	86
		2	60	37	32	23	16	2	13	46	54	67	77
		3	73	53	31	25	22	3	-6	23	55	64	68
		4	69	55	31	22	17	4	0	20	55	68	75

Vs	% Greater than			
ft/hr	S-1	S-2	S-3	S-4
0.021	84	64	45	86
0.042	91	68	45	59
0.042	89	71	82	77
0.063	88	54	77	68
0.083	71	50	64	54
0.083	85	68	77	67
0.083	73	89	86	75
0.125	85	82	59	64
0.167	60	68	77	38
0.167	65	32	59	54
0.167	71	57	68	68
0.250	73	50	18	55
0.333	53	43	59	46
0.333	69	39	59	55
0.500	38	57	14	16
0.500	54	14	32	23
0.667	49	21	23	20
1.000	31	46	-9	13
1.500	26	-7	23	-6
2.000	11	-11	14	0

Figure A-8 presents these results in a set of probability plots that provides an estimate of the distribution of particle settling velocities in the sample. Each of the plots also reports the initial TSS concentration of the sample tested, and the median (50th percentile) value of the distribution. The line that approximates the distribution is a visually estimated line of best fit.

The differences between the four stream stations are relatively small, and a single sample provides no reliable basis for determining whether there are in fact significant differences between the sites. For a preliminary screening, the data from all four tests are pooled to provide an estimate of the approximate order of the settling characteristics of pollutants in the urban streams that discharge to the bay. Table A-8 indicates the procedure used, and tabulates the results. Each of the four removal fractions for a particular depth/time are averaged first. Then, a further average is taken for all sets having the same settling velocity.

Figure A-9 presents a graphical display of the distribution resulting from the pooled results of all four settling column tests. The discontinuity in the relationship at about the 70th percentile may be due to poor test sensitivity at low TSS concentrations, and disruption of test conditions (e.g., the development of thermal currents in the tubes) after long standing periods. The line shown to represent the approximation of the distribution of settling velocities is a visually determined line of best fit.

The scatter in the points shown on the plots in Figure A-8 indicate the limits to the sensitivity of the settling column tests. At the same time, the availability of multiple measurements for different ranges in settling velocity helps to compensate for the uncertainty associated with an individual measurement, and permits a reasonable approximation of the overall distribution to be made.

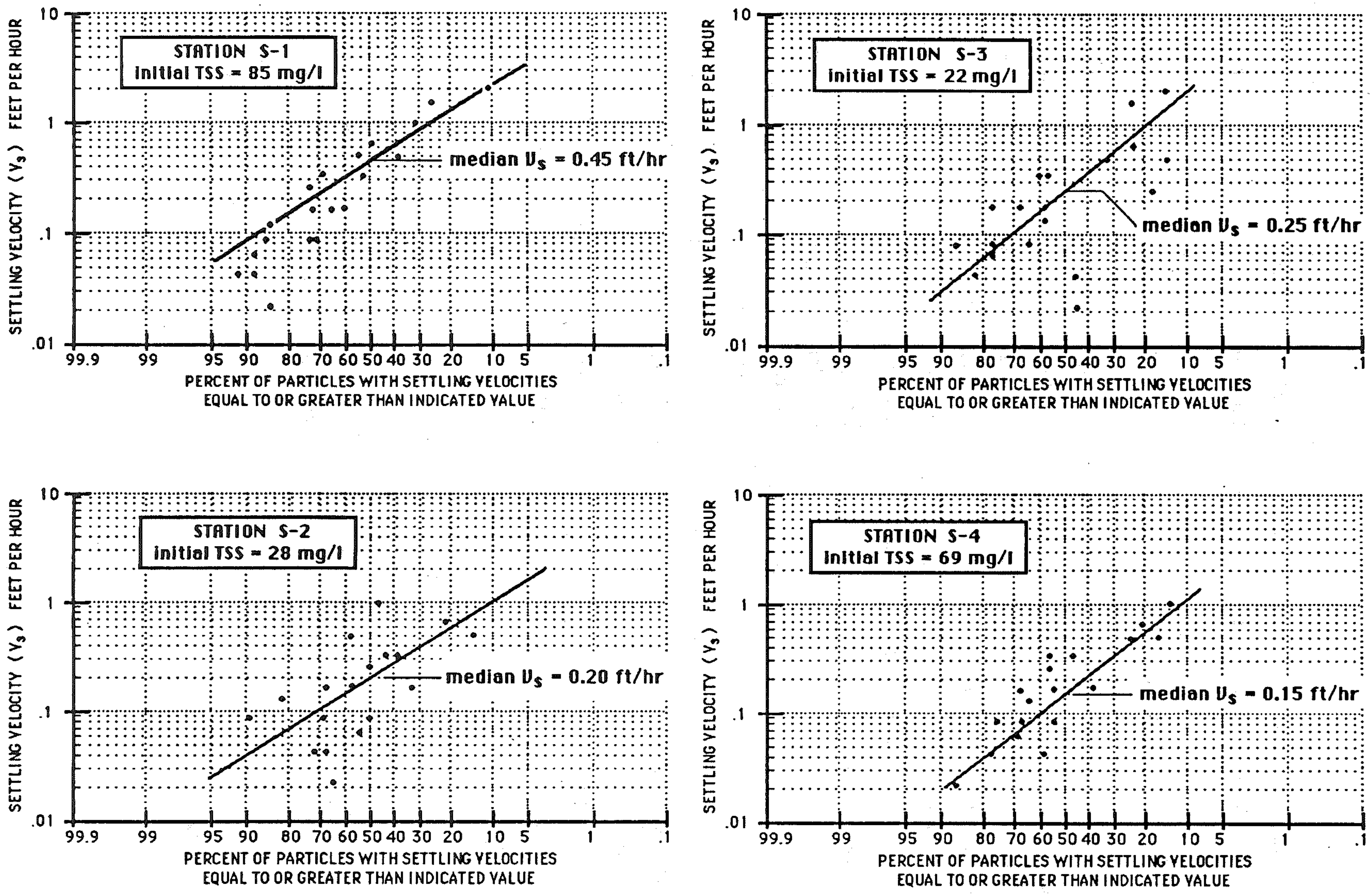


Figure A-8. Probability Plots of the Distribution of Particle Settling Velocities in Sample Stations S-1, S-2, S-3, and S-4

Table A-8. Distribution of Settling Velocities - Pooled Test Results

SETT VELOC Vs ft/hr	% Greater Than				Average % Removal 4 sites	Average % Removal for Vs	SETT VELOC Vs ft/hr
	S-1	S-2	S-3	S-4			
0.021	84	64	45	86	70	70	0.021
0.042	91	68	45	59	66		0.042
0.042	89	71	82	77	80	73	0.042
0.063	88	54	77	68	72	72	0.063
0.083	71	50	64	54	59		0.083
0.083	85	68	77	67	74		0.083
0.083	73	89	86	75	81	72	0.083
0.125	85	82	59	64	72	72	0.125
0.167	60	68	77	38	61		0.167
0.167	65	32	59	54	52		0.167
0.167	71	57	68	68	66	60	0.167
0.250	73	50	18	55	49	49	0.250
0.333	53	43	59	46	50		0.333
0.333	69	39	59	55	56	53	0.333
0.500	38	57	14	16	31		0.500
0.500	54	14	32	23	31	31	0.500
0.667	49	21	23	20	28	28	0.667
1.000	31	46	-9	13	20	20	1.000
1.500	26	-7	23	-6	9	9	1.500
2.000	11	-11	14	0	3	3	2.000

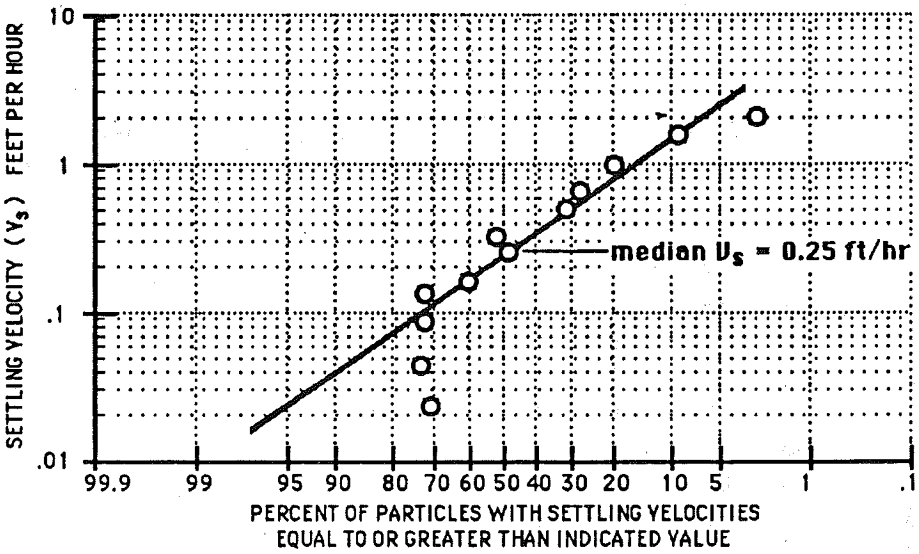


Figure A-9. Distribution of Settling Velocities of Pooled Data for Stream Stations

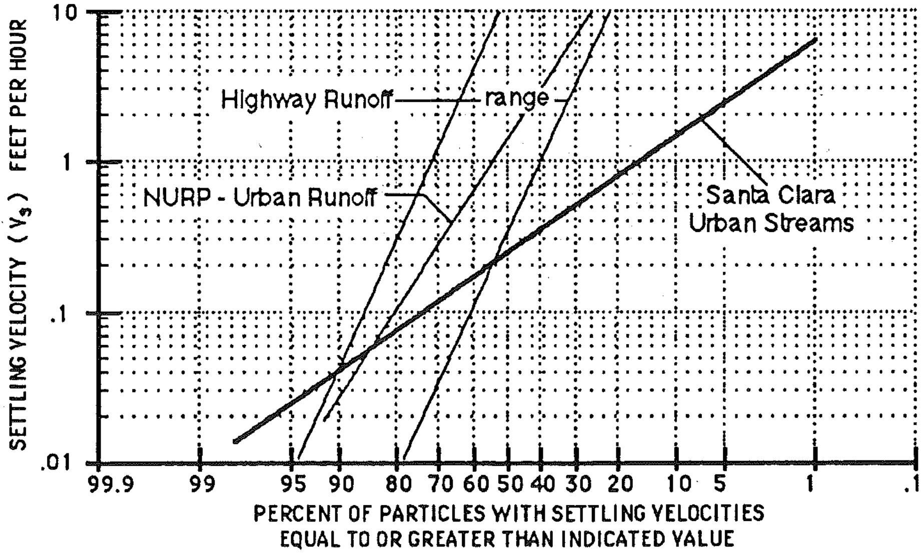


Figure A-10. Comparison of Settling Velocity Distribution from Different Sources

Each of the samples shows a difference in particle sizes, reflected by the median settling velocities for the test, which range between 0.15 and 0.45 ft/hr. Because of the variability and the nature of the test, it would be inappropriate at this point to simply observe that the stream samples tested indicate a median settling velocity on the order of approximately 0.25 ft/hr, and having a distribution approximately as shown by Figure A-9.

These results are compared with the results of similar tests reported in other studies in Figure A-10. The principal indication is that the particulates in the Santa Clara wet weather stream samples are appreciably smaller in size (lower settling velocities) than those measured in direct runoff from urban or highway sites. This type of relationship can be expected if one considers that most of the bigger particles will have settled out rapidly in the stream, and as a result do not show up in these samples.

A.6.9 Special Studies - Fecal Streptococci

Analysis of fecal streptococci, together with fecal coliform, provide insight on possible sources of fecal contamination. Ratios of fecal coliform to fecal streptococci provide some indication as to whether the contamination was of human or nonhuman origin. Ratios in excess of 4.1 are sometimes considered to be primarily of human origin, whereas ratios less than 0.7 are considered to be of nonhuman origin. Ratios between 0.7 and 4.1 may be indicative of mixed human and nonhuman fecal contamination (Standard Methods 1980).

A survey of fecal streptococci and coliform bacteria was conducted at the four stream sites in order to assess possible sources of fecal contamination in nonpoint source runoff during storm events. Grab samples were taken at stream sites S1 through S4 during the third Wet-Weather Water Quality event in January 23, 1989. The analyses for both types of bacteria were conducted in accordance with Standard Methods for the Examination of Water and Wastewater (1980).

Results of the fecal streptococci are presented in Appendix D.2-1. Ratios of fecal coliform to fecal streptococci show values ranging from about 1 (S3 and S4) to 10 (S1 and S2).

A.6.10 Subsampling Procedures, Sample Containers, and Preservatives

The 10-liter composite samples collected from the autosamplers during storm events were sealed with Teflon-lined polyethylene caps, packed in ice, and transported to Kinnetic Laboratories, Inc., in Santa Cruz for further processing. When multiple 10-liter bottles were collected for a single station, it was first necessary to thoroughly blend the samples. Blending of the composite samples was accomplished by use of a peristaltic pump and Teflon hose.

The peristaltic pump was also used to draw samples for each set of analyses. Samples for each analyses were placed in prelabeled containers with appropriate preservatives (see Table A-9). Whenever possible, analyses requiring common containers and preservation were placed in the same container in order to minimize sample handling.

Grab samples for analysis of sediment were placed directly into appropriate sample containers (see Table A-10). In most situations, common containers were used for collection and holding of sediments to be analyzed for (1) trace metals and inorganics and (2) volatile and semi-volatile organics. Single containers were utilized for organochlorine pesticides, chlorinated herbicides, and polynuclear aromatic hydrocarbons.

A.6.11 Field QA/QC

Several external or field quality control procedures were used to evaluate potential errors which could have been introduced during sample collection and subsequent analytical procedures. These external quality control checks were performed by blind submission of blanks and duplicates.

Table A-9. CONTAINERS, PRESERVATIVES, AND HOLDING TIMES FOR AQUEOUS SAMPLES

Class	Min. Volume Utilized (ml)	Container	Preservation	Holding Time
Organics				
Total Organic Halogen (TOX)	250	G (amber) Teflon cap	Cool, 4°C H_2SO_4 to pH<2	7 days
Total Organic Carbon (TOC)	125	G (amber) Teflon cap	Cool, 4°C H_2SO_4 to pH<2	28 days
Volatiles, GC/MS	125	G (amber) Teflon cap	Cool, 4°C	14 days
Semi-volatiles, GC/MS	1000	G (amber) CH_3Cl rinse	Cool, 4°C 40 d(anal.)	7 d(extract)
Organochlorine pesticides	1000	G (amber) CH_3Cl rinse	Cool, 4°C 40 d(anal.)	7 d(extract)
Chlorinated herbicides	1000	G (amber) CH_3Cl rinse	Cool, 4°C 40 d(anal.)	7 d(extract)
PNA	1000	G (amber) CH_3Cl rinse	Cool, 4°C 40 d(anal.)	7 d(extract)
Organophosphate pesticides	1000	G (amber) CH_3Cl rinse	Cool, 4°C 40 d(anal.)	7 d(extract)
Metals				
Total	500	P	Cool, 4°C HNO_3 to pH<2	6 months
• Chromium, hexavalent	200	P	Cool, 4°C	24 hours
• Mercury	100	P	Cool, 4°C HNO_3 to pH<2	28 days

Table A-9. CONTAINERS, PRESERVATIVES, AND HOLDING TIMES FOR AQUEOUS SAMPLES (concluded)

Class	Min. Volume Utilized (ml)	Container	Preservation	Holding Time
Metals (continued)				
Dissolved	500	P	Cool, 4°C Filter, HNO_3 to pH<2	6 months
• Chromium, Hexavalent	200	P	Cool, 4°C	24 hours
• Mercury	100	P	Cool, 4°C HNO_3 to pH<2	28 days
Nutrients				
Total Kjeldahl Nitrogen (TKN)	200	P	Cool, 4°C	28 days
Ammonia (NH_3-N)	200	P	H_2SO_4 to pH<2	
Nitrite (NO_2-N)	15	P		
Nitrate (NO_3-N)	15	P		
Total Phosphate	50	P		
Bacteria				
Total and fecal coliform	100	P	Cool, 4°C	6 hours
Fecal streptococcus	100	P	Cool, 4°C	6 hours
Others				
BOD_5	300	G	Cool, 4°C	6 hours
COD	100	P	H_2SO_4 to pH<2	7 days
Total Suspended Solids (TSS)	100	P	Cool, 4°C	7 days
Total hardness	100	P	HNO_3 to pH<2	6 months

P = Plastic laboratory container
G = Glass laboratory container

Table A-10. CONTAINERS, PRESERVATIVES, AND HOLDING TIMES FOR SEDIMENT SAMPLES

Class	Min. Volume Utilized (ml)	Container	Preservation	Holding Time
Organics				
Total Organic Carbon (TOC)	125	G (amber) Teflon septum	Cool, 4°C H_2SO_4 to pH<2	28 days
Volatiles, GC/MS	500	G (amber) wide-mouth Teflon lid	Cool, 4°C	14 d(extract) 40 d(anal.)
Semi-volatiles, GC/MS	500	G (amber) wide-mouth Teflon lid	Cool, 4°C	14 d(extract 40 d(anal.)
Organochlorine pesticides	125	G (amber) Teflon septum	Cool, 4°C	14 d(extract) 40 d(anal.)
Chlorinated herbicides	370	G (amber) wide-mouth Teflon lid	Cool, 4°C	14 d(extract) 40 d(anal.)
PNA	250	G (amber) wide-mouth Teflon lid	Cool, 4°C	7 d(extract) 40 d(anal.)
Organophosphate pesticides	250	G (amber) wide-mouth Teflon lid	Cool, 4°C	7 d(extract) 40 d(anal.)
Metals				
Total	250	P HNO_3 to pH<2	Cool, 4°C	6 months
Nutrients				
Total Kjeldahl Nitrogen (TKN)	200	P	Cool, 4°C	28 days
Ammonia (NH_3-N)	200	P	Cool, 4°C	28 days

Table A-10. CONTAINERS, PRESERVATIVES, AND HOLDING TIMES FOR SEDIMENT SAMPLES (concluded)

Class	Min. Volume Utilized (ml)	Container	Preservation	Holding Time
Others				
BOD_5	300	G	Cool, 4°C	
COD	100	P	H_2SO_4 to pH<2	7 days
Grain size distribution	50	P	Cool, 4°C	

P = Plastic laboratory container
G = Glass laboratory container

Blanks used in the field QA/QC procedures consisted of both field blanks and trip blanks. Field blanks were used to assess errors due to bottle contamination and field sampling procedures. Field blanks were obtained by sampling contaminant-free waters (furnished by the laboratory) using procedures identical to those used for collection of field samples. The field blanks for samples taken from the composite samplers were obtained by pumping contaminant-free waters into sample containers. This same procedure was used to extract field samples from the composite sample. Field blanks for grab samples were obtained by pouring blank water into a sample container. Trip blanks were utilized to assess potential contamination from both sample containers and coolers used for sample transportation. These blanks consisted of contaminant-free water provided in a standard sample container by the laboratory. These blanks remained unopened in the coolers and were returned to the laboratory for analysis.

Field duplicates were utilized to evaluate data precision. Analysis of these types of control samples provide a measure of the variability due to natural factors in the water body, sampling procedures and analytical procedures. Field duplicates were collected in the same manner as the primary samples and submitted blind to the laboratory.

A third quality control check conducted as part of the field program was quarterly analysis of external spike samples. Samples containing certified levels of contaminants were purchased from ERA laboratories in Colorado and the National Bureau of Standards (PNAs only). These samples were received by the project QA/QC officer. The QA/QC officer then removed certification information and submitted the samples to each laboratory under chain-of-custody.

A.7 LABORATORY ANALYSIS

A.7.1 Constituents and Methods

All analytical methods were either EPA or Standard Methods approved. All constituents and analytical methodologies used in this study are listed in Tables A-11 (water) and A-12 (sediments). All analytical method numbers cited in these tables refer to the following standard laboratory references:

- "SM":
  APHA-AWWA-WPCF. 1985. Standard Methods for the Examination of Water and Wastewater - 16th Edition.

- "Plumb":
  Plumb, Jr., R.H. 1981. Procedures for Handling and Chemical Analysis of Sediment and Water Samples. Prepared by Environmental Protection Agency/Corps of Engineers Technical Committee on Criteria for Dredged and Fill Material 81-4. Environmental Laboratory U.S. Army Engineer Waterways Experiment Station, Vicksburg, Mississippi.

- "EPA":
  U.S. Environmental Protection Agency. 1979 (Revised 1983). Methods for the Chemical Analysis of Water and Wastes. (EPA 600/4-79-020).

  U.S. Environmental Protection Agency. 1986. Test Methods for Evaluating Solid Waste, U.S. EPA SW-846, September 1986.

  U.S. Environmental Protection Agency. 1982. Methods for Organic Chemical Analysis for Municipal and Industrial Wastewater, (EPA 600/4-82-057).

Table A-11. WATER QUALITY CONSTITUENTS AND TEST METHODS

Class	Constituent	Test Method
Organics	Total Organic Halogen (TOX)	EPA 9020
	Total Organic Carbon (TOC)	EPA 9060
	Volatiles (Purgeables), GC/MS	EPA 624
	Semi-volatiles (Base/Neutrals), GC/MS	EPA 625
	Organochlorine pesticides	EPA 608
	Chlorinated herbicides	EPA 8150
	Polynuclear Aromatic Hydrocarbons (PNA)	EPA 8100/610
	Organophosphate pesticides	EPA 614
Metals	Arsenic	EPA 206.2
	Cadmium	EPA 213.2
	Chromium, total	EPA 218.2
	Chromium, hexavalent	EPA 218.5
	Copper	EPA 220.2
	Lead	EPA 239.2
	Mercury	EPA 245.1
	Nickel	EPA 249.2
	Selenium	EPA 270.3
	Silver	EPA 272.2
	Zinc	EPA 289.2
Nutrients	Total Kjeldahl Nitrogen (TKN)	SM 420A
	Ammonia (NH_3-N)	SM 417D
	Nitrite (NO_2-N)	SM 419
	Nitrate (NO_3-N)	SM 418C
	Total Phosphate	SM 424F
Bacteria	Total coliform	SM 908A
	Fecal coliform	SM 908C
	Fecal streptococcus	SM 910A
Others	Five-day Biochemical Oxygen Demand (BOD_5)	SM 507
	Chemical Oxygen Demand	SM 508A
	Total Suspended Solids (TSS)	SM 209C
	Total hardness	EPA 130.2

Table A-12. SEDIMENT QUALITY CONSTITUENTS AND TEST METHODS

Class	Constituent	Test Method
Organics	Total Organic Carbon (TOC)	EPA 9060
	Volatiles (Purgeables), GC/MS	EPA 8240
	Semi-volatiles (Base/Neutrals), GC/MS	EPA 8270
	Organochlorine pesticides	EPA 8080
	Chlorinated herbicides	EPA 8150
	Polynuclear Aromatic Hydrocarbons (PNA)	EPA 8100/610
	Organophosphate pesticides	EPA 8140
Metals	Arsenic	EPA 206.2
	Cadmium	EPA 213.2
	Chromium, total	EPA 218.2
	Chromium, hexavalent	EPA 218.5
	Copper	EPA 220.2
	Lead	EPA 239.2
	Mercury	EPA 245.1
	Nickel	EPA 245.1
	Selenium	EPA 270.3
	Silver	EPA 272.2
	Zinc	EPA 289.2
Nutrients	Total Kjeldahl Nitrogen (TKN)	SM 417D
	Ammonia (NH_3-N)	SM 417D
Others	Five-day Biochemical Oxygen Demand (BOD_5)	SM 507
	Chemical Oxygen Demand	SM 508A
	Sediment grain size distribution	Plumb

A.7.2 Laboratory QA/QC

Laboratory procedures used to monitor bias and precision in analytical measurements included the following:

- Use of full-range internal calibration standards
- Analysis of laboratory blank water for every 10 samples analyzed by each methodology
- Analysis of a laboratory spike for every 10 samples
- Laboratory splits on 10 percent of the field samples submitted to the laboratory

Spikes were intended to evaluate the overall accuracy of the data set. Although spiking of either field samples or contaminant-free blank water was permitted by the project QA/QC plan, all spikes were performed using field samples in order to account for possible matrix interferences.

The laboratory blanks were conducted as part of each participating laboratories quality assurance plans. These blanks provided a measure of potential sources of contamination to the samples.

Laboratory splits were utilized to evaluate the precision of the analytical measurements. The duplicate data were used to calculate relative percent difference (RPD) values for each constituent. Upper and lower control limits based upon 95 percent confidence limits of historical laboratory splits were used to evaluate analytical precision and acceptability of the data.

A.8 DATA MANAGEMENT

Hardcopies of analytical chemistry results received from each contract laboratory were entered into a spreadsheet database using Lotus 1-2-3. Separate spreadsheets were maintained for each major chemical analysis (e.g., PNAs, organochlorine pesticides) or class of analyses (e.g., physical data-TSS, pH).

Each spreadsheet contained information on the type of sample (e.g., dry-weather, wet-weather), station identification, a sequential event number, date of sampling, analytical laboratory sample identifier, and target detection limits for each analyte. Reported values and actual detection limit on the laboratory report were recorded for each analyte.

Copies of the individual laboratory reports (hardcopy), chain-of-custody documents, and the complete Lotus 1-2-3 database were provided to Woodward-Clyde Consultants by Kinnetic Laboratories, Inc.

APPENDIX B
HYDROLOGIC MODEL CALIBRATION AND VERIFICATION

APPENDIX B
HYDROLOGIC MODEL CALIBRATION AND VERIFICATION

Stormwater quality loads for 11 watersheds were estimated by first determining the loads from each land use in each watershed, and then summing loads from all land uses to produce loads to the bay. Because land use loads were calculated as the product of flow volume and concentration, this methodology required estimates of 1) the volume of runoff from each land use category, and 2) the average concentration of pollutants from each land use category.

This Appendix describes the procedures used to estimate flow volumes. Section B.1 provides an overview of the Stormwater Management Model (SWMM), the rainfall-runoff model used to estimate flow volumes. Section B.2 describes the model setup for the Santa Clara Valley, Section B.3 discusses model calibration and verification, and Section B.4 presents estimates of stormwater runoff volumes for the Santa Clara Valley.

B.1 OVERVIEW OF SWMM

The review of hydrologic data presented in Section 5.0 provides insight into the historical magnitude and variability of rainfall and runoff in the Santa Clara Valley. However, to estimate nonpoint source loads, knowledge of the sources of storm runoff is required. Runoff from undeveloped areas will differ in terms of water quality from runoff in urban areas on the valley floor, and little can be learned about the apportionment of runoff between developed and undeveloped areas through analysis of existing streamflow records alone. Unless one is willing to install and operate many more stream gages for several years, the preferred way to estimate runoff from individual land uses and from ungaged areas is by using a rainfall-runoff model.

Rainfall-runoff models use physical and land use information about a catchment to calculate storm runoff from a given rainfall record. Rainfall-runoff models vary in complexity from relatively simple models such as the Rational Method (Linsley et al. 1982), to models which attempt to represent in detail the physical mechanisms through which rainfall is converted to runoff.

In this study, the U.S. EPA Stormwater Management Model Version IV (Huber et al. 1988) was used to estimate runoff volumes from land use areas for loads calculations. This model, referred to as SWMM, contains a detailed mathematical description of the hydrologic cycle, including runoff, from impervious and pervious areas, infiltration, percolation to the water table, groundwater flow into channels, losses due to evapotranspiration, interception, and depression storage, and routing of runoff down stream channels. The model also has water quality and treatment components which are useful in evaluating the effects of control measures. Thus, SWMM is sufficiently detailed and general in scope to model the processes which are relevant to the estimation of nonpoint source loads.

SWMM represents a watershed as a set of hydrologic units referred to as subcatchments. Each subcatchment is assumed to have a unique set of runoff properties, including rainfall, area, width, slope, infiltration characteristics, and percent of impervious areas. The model simulates runoff over time using time steps determined by the interval at which rainfall data are available. For accurate simulation of storm hydrographs, this time step is typically on the order of 15 to 60 minutes. At each time step, the model performs a water balance on all subcatchments, as illustrated in Figure B-1. The volume of water available for surface runoff is determined by first subtracting losses for depression storage, infiltration, and evaporation from rainfall. The remaining water is routed

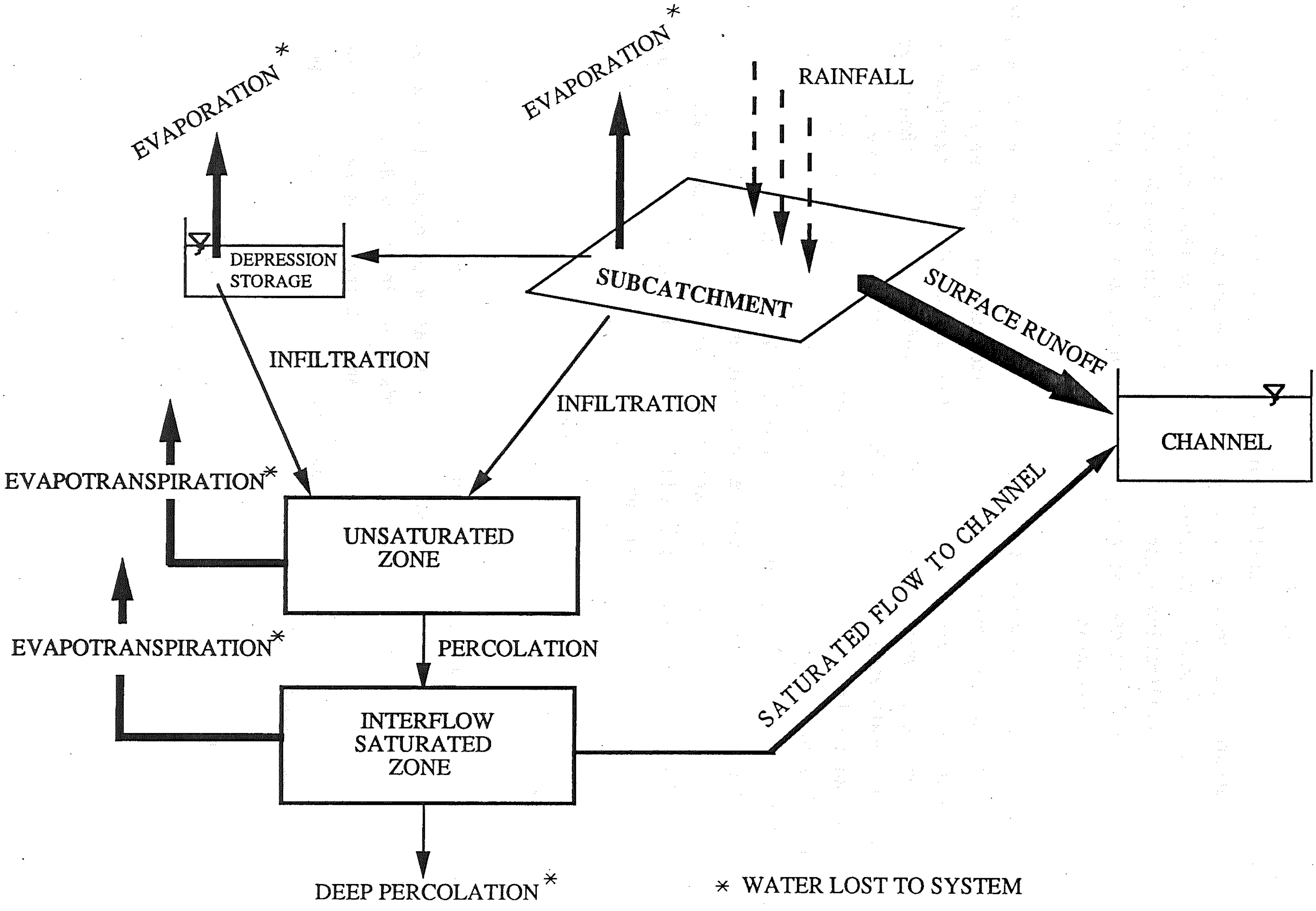


FIGURE B-1. SWMM Water Balance For a Subcatchment as runoff from the subcatchments into channels using a non-linear reservoir routing scheme, with the outflow rate determined by Manning's equation. Each subcatchment contains both pervious and impervious areas; runoff is more rapid from impervious areas because rainfall on these areas is not subject to infiltration losses. Water in depression storage, used to simulate storage in depressions on the ground surface, may either infiltrate or evaporate.

The subsurface component of the hydrologic cycle is represented in SWMM by two storage reservoirs, one for the unsaturated zone and one for the saturated zone. The volume of infiltration is determined using either a Horton or a Green-Ampt infiltration model. Infiltrated water then moves into the unsaturated zone, where it may either remain in storage, evapotranspirate, or percolate into the saturated zone. Water in the saturated zone may either remain in storage, flow into channels, or percolate out of the system. Flow from the saturated zone to channels is determined based on the difference in elevation between the water table and the channel water surface; the water table elevation is recalculated each time step based on the current volume of water in the saturated zone and the porosity of the saturated zone.

B.2 MODEL SETUP FOR THE SANTA CLARA VALLEY

The goal of this study was to estimate total nonpoint source loads from the Santa Clara Valley. Thus, SWMM was used to model runoff from the entire valley. For data management and calibration purposes, the valley was subdivided into the 11 major watersheds shown in Figure B-2. Streamflow data for calibration were available at the downstream ends of six of these watersheds; runoff from the remaining watersheds was estimated using SWMM without calibration.

Prior to using SWMM, a conceptual model of the important runoff processes occurring in the valley was developed. Based on the analysis of

WATERSHED	AREA* (sq miles)	% of TOTAL
① Coyote	124	33
② Guadalupe	108	28
③ San Tomas Aquinas	28	7
④ Saratoga	17	4
⑤ Calabazas	21	6
⑥ Sunnyvale East Channel	7	2
⑦ Sunnyvale West Channel	5	2
⑧ Stevens Creek	12	3
⑨ Permanente Creek	17	4
⑩ Adobe Matadero Barron	34	9
⑪ San Francisquito (Santa Clara County)	7	2
	380	100

* Does not include areas above reservoirs

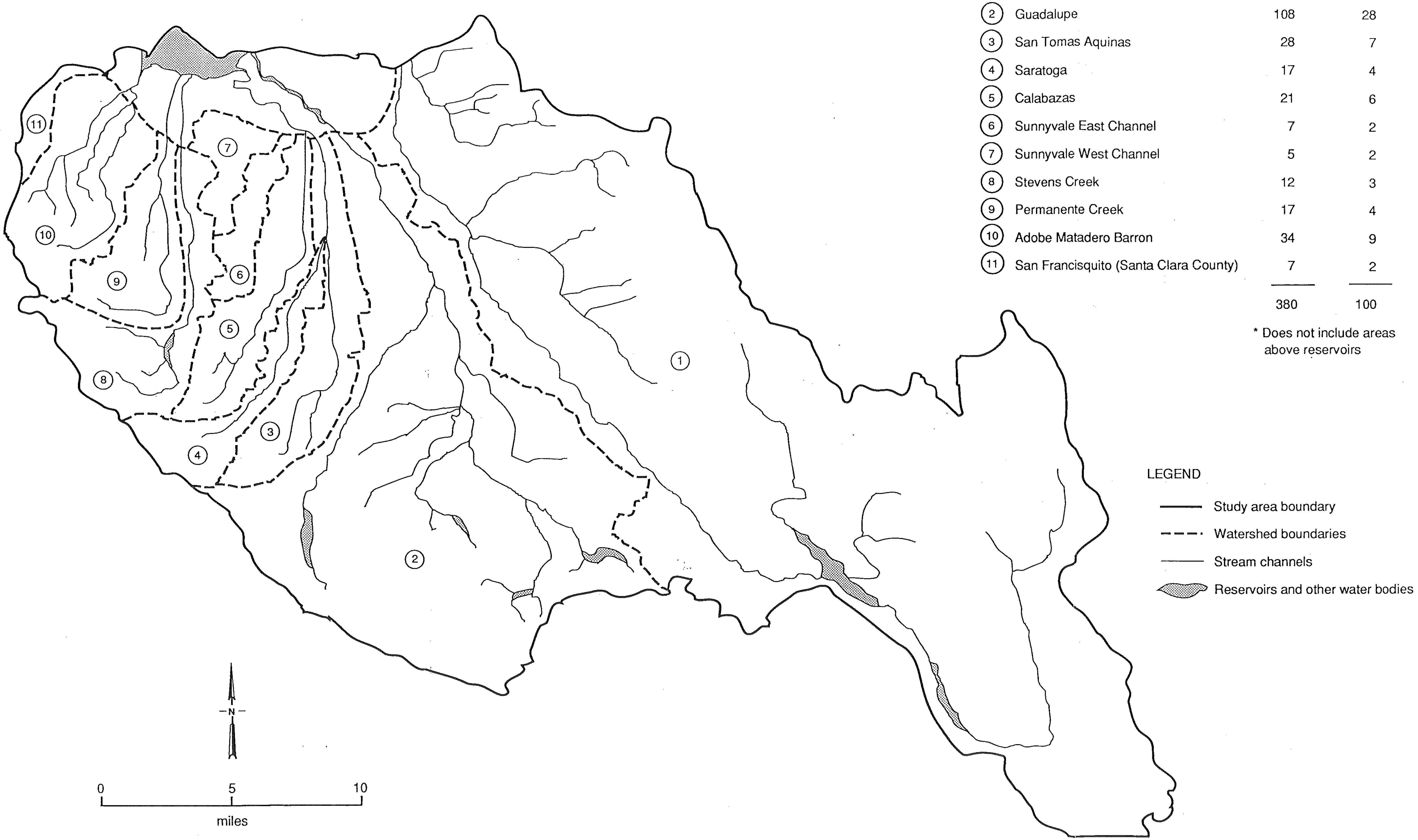


Figure B-2. WATERSHEDS IN STUDY AREA

measured flow and precipitation data presented in Section 5.0, the following concepts were used to guide the application of SWMM to the study area:

1) Orographic effects on rainfall are strong, especially in the Santa Cruz Mountains.

2) Runoff on the valley floor occurs primarily from impervious areas associated with urban development.

3) Runoff from pervious areas occurs primarily in the Santa Cruz Mountains where rainfall intensities are sufficient to exceed soil infiltration capacities.

4) Runoff from pervious areas has a seasonal component, with the strongest runoff response occurring in the late wet season when antecedent soil moisture levels are highest.

5) Storm hydrographs typically have a 2- to 3-day recession component derived from subsurface flow rather than from surface runoff. This subsurface flow is probably interflow through temporarily saturated areas and perched groundwater in the unsaturated zone.

These concepts were used in determining how the SWMM runoff, infiltration, and groundwater algorithms were configured for this study, and will be referred to in terms of specific model parameters in the following sections. Section B.2.1 discusses how watersheds were subdivided into SWMM subcatchments, and Section B.2.2 describes procedures used to estimate model input parameters.

B.2.1 Watershed Discretization

The number and size of subcatchments used by SWMM should be determined by (1) the level of detail required in the model results, and (2) the level of detail at which data are available. For this study, complete data were available for relatively small subcatchments used by the Santa Clara Valley Water District (SCVWD) for their flood hydrograph modeling. However, this level of detail, while important for flood modeling, is not necessary for estimating annual-scale runoff and water quality loads. Huber and Dickenson (1988) present data and examples showing that small subcatchments can be lumped into larger SWMM subcatchments with little loss of information, as long as input parameters are scaled appropriately.

Because orographic effects on rainfall are so important in the Study Area, the first step in setting up subcatchments for this study was to divide each watershed into subareas over which rainfall was assumed to be uniformly distributed. The number of subareas were selected such that the variability of rainfall within watersheds was adequately represented. Figure B-3 illustrates the subarea breakdown for the Calabazas Creek watershed. The subareas shown are typical of those used in the smaller watersheds in the western part of the valley, with three subareas representing rainfall on 1) the lower valley floor, 2) the upper valley floor, and 3) the Santa Cruz Mountain foothills. Table B-1 summarizes the rain gages used to model runoff for all of the watersheds in the Study Area.

SWMM performs water balance calculations and estimates flows for areas represented by subcatchments. Thus, to estimate flows from individual land uses each rain gage subarea was divided into subcatchments for up to six land use categories (open, low density residential, medium density residential, high density residential, commercial, and industrial). These land use subcatchments represented "lumped areas" in that all of the areas of a given land use were modeled as a single contiguous subcatchment. In the example shown in Figure B-3, rain gage subarea 100 was subdivided into an open subcatchment, a low residential subcatchment, and a medium residential subcatchment. Because the land use breakdown for the area was 43 percent open, the open subcatchment had an area equal to 43 percent of

Table B-1. RAIN GAGES USED TO MODEL RUNOFF IN EACH WATERSHED

Watershed	Rain Gages[a]	Calibrated?
Coyote Creek	NWS, 37, 123, 23, 99	yes
Guadalupe River	NWS, 1, 36, 123, 128	yes
San Tomas Aquinas Creek	NWS, 79, 108	yes
Saratoga Creek	77, 108	yes
Calabazos Creek	100, 108, 121	yes
Sunnyvale East	48	yes
Sunnyvale West	121	no
Stevens Creek	48, 100, 121	yes
Permanente Creek	48, 53, 100, 121	no
Adobe - Matadero - Barron	24, 48, 53	no
San Francisquito Creek	24, 53	no

---

[a] Rain gage numbers are based on the SCVWD numbering system. NWS refers to the San Jose National Weather Service gage.

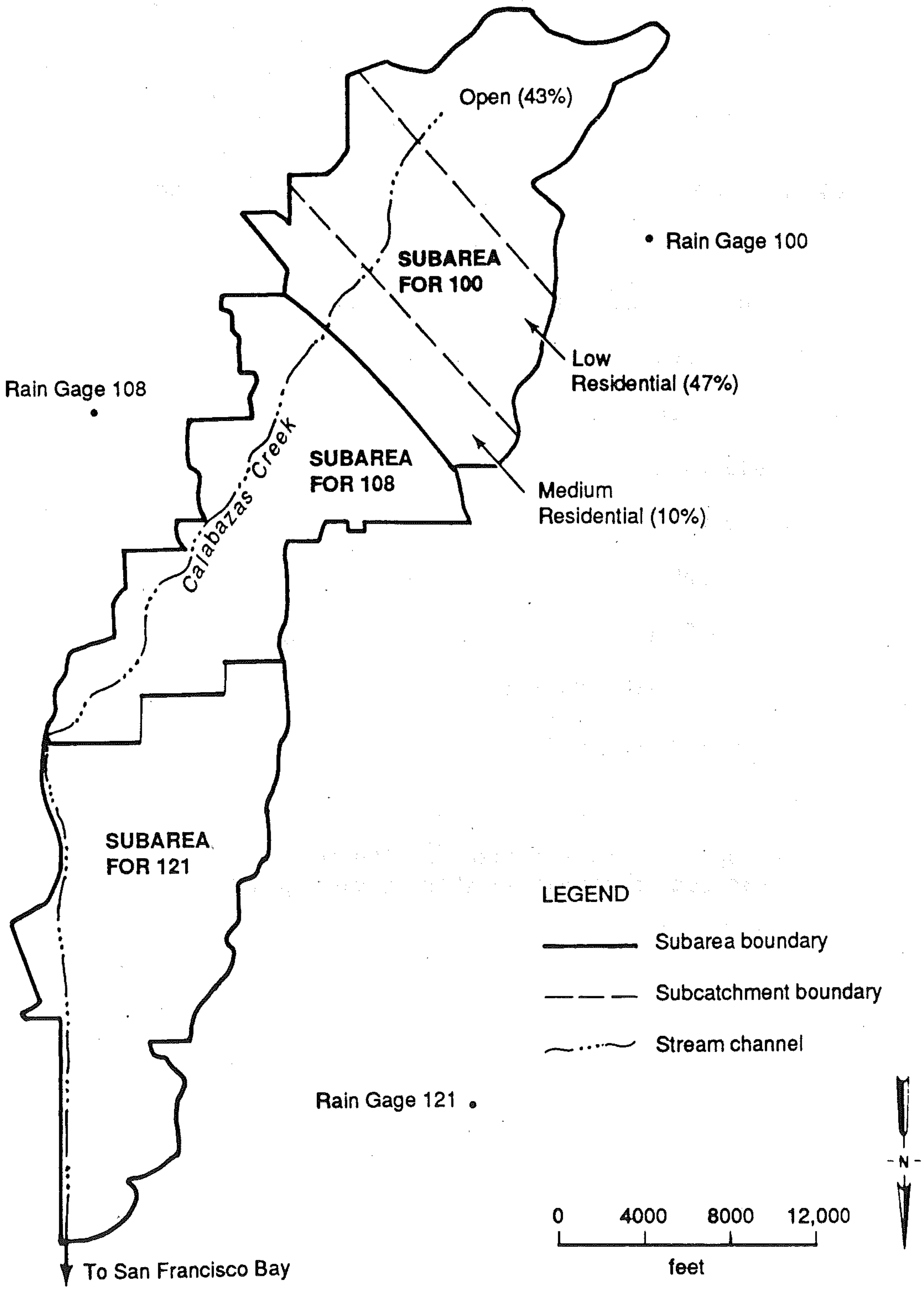


Figure B-3. SUBCATCHMENT BREAKDOWN FOR CALABAZAS CREEK the total area represented by rain gage 100. In general, physical properties such as rainfall, subcatchment width, and soil infiltration parameters were identical for all land use subcatchments in a given rain gage subarea. Land use properties such as impervious area were allowed to vary between land use subcatchments to reflect different levels of development.

B.2.2 Model Parameter Estimation

SWMM requires a number of parameters describing meteorology, catchment geometry, and runoff characteristics. The accuracy at which parameters can be estimated without model calibration varies. Thus, parameters can be grouped as follows:

1) Parameters which can be accurately estimated with no calibration (i.e., catchment area)

2) Parameters which can be estimated with reasonable accuracy, but must be refined through calibration (i.e., infiltration parameters)

3) Parameters which can be estimated only through model calibration (i.e., interflow outflow coefficients)

Table B-2 summarizes the important model input parameters and the corresponding estimation procedures; these are discussed in detail in the following paragraphs.

B.2.2.1 Rainfall. Rainfall is the driving force in the model, and is by far the most important input parameter. SWMM in this case was run continuously for multiple-year simulations, and required continuous records of 15-minute or hourly rainfall. Therefore, the continuous rainfall records available for SCVWD and NWS gages in the valley were used as inputs to the model. The SCVWD gages are weighing gages which record at 15-minute intervals with a precision of 0.1 inch. The one NWS gage, located in San

Table B-2. SUMMARY OF SWMM RUNOFF INPUT PARAMETERS

Parameters	Estimation Procedure	Varies by Land Use?	Calibration Parameter?
Rainfall (in.)	NWS hourly and SCVWD 15-minute recording weighing gages (1974-1989). To correct for orographic effects, rainfall records were multiplied by isohyetal correction factors based on the ratio of average annual rainfall for subareas to the average at the gage.		
Potential Evapotranspiration Rate (in./day)	Average monthly pan evaporation data at the Alamitos Recharge Facilities, multiplied by monthly pan coefficients provided by the SCVWD.		
Area (acres)	Drainage areas were measured from drainage maps provided by the SCVWD.		
Slope (fraction)	Slopes were determined by area-weighting slopes for those SCVWD catchments contained in model subcatchment.	•	
Land Use (%)	Land use percentages were determined by area-weighting values for SCVWD catchments contained within each SWMM subcatchment.	•	
Catchment Width (feet)	Drainage area divided by the maximum length of overland flow.		•
Impervious Area (%)	Derived from calibration of SWMM for monitored land use catchments (Station L1-L7) for the 1988-89 season.	•	•
Surface Roughness	Values for each land use were derived from tables for grassy, paved, and forested surfaces in the SWMM User's Manual.	•	
Depression Storage (in.)	Values for each land use were derived from tables for grassy and paved surfaces in the SWMM User's Manual.	•	•
Infiltration Parameters	Hydrologic soil groups were mapped from Soil Conservation Service (SCS).	•	•
Interflow Parameters	Soil surveys (1941). Typical values for each soil group were then selected from tables in the SWMM User's Manual. The average for a SWMM subarea was determined by area-weighted averaging.		
Unsaturated zone	From typical values tabulated in SWMM user's manual for soil types surveyed by the SCS (1941).		•
Saturated zone	From typical values tabulated in SWMM user's manual for soil types surveyed by the SCS (1941).		•
Outflow coefficients	By calibration to match measured hydrographic recessions.	•	•

Jose, is an hourly gage with a precision of 0.01 inch. A detailed description of these data is provided in Section 5.1.

The rainfall record for each subcatchment was selected by first identifying the rain gage located nearest to the centroid of the subcatchment area. The record for this rain gage then became the base rainfall record for the subcatchment. In selecting a base rainfall record, we also compared the elevation of the rain gage to that of the subcatchment (i.e., if the nearest gage were on a high ridge above the subcatchment, another gage at an elevation closer to that of the subcatchment was sometimes selected as a more representative record).

Once a base record was established for the subcatchment, the rainfall record was adjusted for the average difference between rainfall volumes in the subcatchment and at the rain gage. To accomplish this, rainfall records were multiplied by correction factors based on the ratio of average annual precipitation in the subcatchment to average annual precipitation in the rain gage:

$$R_{sc} = R_g * (P_{sc}/P_g) \qquad \text{(B-1)}$$

where

R_{sc} = 15-minute rainfall values used in modeling the sub catchment (in)
R_g = the corresponding 15-minute rainfall in the rain gage (in)
P_{sc} = the mean annual rainfall in the subcatchment (in)
P_g = the mean annual rainfall in the rain gage (in)

The mean annual rainfall for the catchment was estimated from annual average rainfall isohyets. Rainfall isohyets were derived from isohyetal maps provided by the SCVWD.

Storm patterns within a year can be highly variable, and this correction of rainfall records based on long-term annual average rainfall totals will certainly not capture all of the spatial variability within an individual storm. However, the method does ensure that, on average, the rainfall record used in modeling runoff will have the correct cumulative volume. This method should therefore be sufficiently accurate for estimating annual flow volumes and loads.

B.2.2.2 Potential Evapotranspiration Rate. The potential evapotranspiration rate determines how much water could be lost to evaporation and transpiration. SWMM uses an average rate for each month of the year; for this study, these rates were estimated using the average monthly pan evaporation rates measured by the SCVWD at the Alamitos Recharge Facility. These pan evaporation rates were corrected by pan coefficients provided by the SCVWD.

B.2.2.3 Catchment Area, Slope, and Land Use. These data were available for catchments used by the SCVWD in their flood modeling. These catchments were smaller than the SWMM subcatchments used in this study. Consequently, model subcatchment areas were determined from the SCVWD catchment maps by summing the areas for the appropriate SCVWD catchments. Similarly, slopes and land use breakdown were determined by area-weighting the values for the SCVWD catchments comprising a SWMM subcatchment.

B.2.2.4 Catchment Width. SWMM represents each subcatchment as a rectangle defined by an area and width; the length of overland flow is then the area divided by the width. Catchment width is therefore an important parameter in determining the timing of runoff. This width is difficult to measure, since the actual shapes of subcatchments are rarely rectangular. As recommended in the SWMM Users Manual (Huber and Dickensen 1988), a first estimate of this parameter was obtained by dividing the subcatchment area by the maximum distance from catchment boundary to the main channel.

B.2.2.5 Impervious Area. This parameter is defined as the percentage of an area that has no infiltration, i.e., paved areas, rooftops, etc. Impervious areas must also be connected, and paved areas that drain onto pervious areas should not be considered impervious. This parameter could conceivably be measured directly from aerial photos, but this would be extremely costly and of questionable accuracy for an area as large as the Santa Clara Valley.

The approach used here was to determine representative impervious areas for each land use by calibrating SWMM on storm data at the single land use catchments sampled in this study. These values were then adjusted during calibration of the larger watersheds to match observed runoff volumes.

B.2.2.6 Surface Roughness Coefficients and Depression Storages. These were estimated for pervious and impervious areas using values tabulated in the SWMM user's manual for various types of surfaces. Values tabulated for either paved, grassy, or forested surfaces were selected based on land use. Depression storages were also calibrated in forested areas to represent interception on vegetation.

B.2.2.7 Infiltration Parameters. For this study, the Green-Ampt option in SWMM was selected for modeling infiltration during storm events. The Green-Ampt infiltration model, while certainly idealized, is mechanistically rather than empirically based and has input parameters that can easily be related to known soil properties. For infiltration during storms, the model uses three parameters: 1) the saturated hydraulic conductivity, 2) a suction parameter, and 3) the maximum soil moisture deficit. The saturated hydraulic conductivity represents the infiltration rate at saturation. The suction parameter is used to model the effects of capillary suction in the soil. The maximum moisture deficit is analogous to porosity and determines the storage capacity of the soil layer that controls infiltration. Values of these parameters are tabulated for each of the four Soil Conservation Service (SCS) hydrologic soil groups in the SWMM User's Manual. Therefore, values for this study were determined by overlaying SCS soil survey maps (SCS 1941) onto maps of the SWMM subcatchments. The area of soils in each SCS hydrologic group were measured, and the average parameters for the watershed were determined by area weighting. The following calculation illustrates the method for the saturated hydraulic conductivity:

$$K = (\%A)(KA) + (\%B)(KB) + (\%C)(KC) + (\%D)(KD) \qquad \text{(B-2)}$$

where:

K = the average saturated hydraulic conductivity for a subcatchment
A, B, C, D = the four SCS hydrologic soil groups
%A = the percentage of the total area that are A soils
KA = the value of saturated hydraulic conductivity for A soils

In general, soils in the area ranged from B to D, where D soils have the lowest infiltration rates.

Between storms, SWMM uses a simple empirical algorithm to determine how dry soils are at the start of the next storm. As previously discussed, the antecedent soil moisture level is an important factor in determining runoff response in the Study Area, especially in the later months of the rainy season. Initial calibration of SWMM indicated that the empirical SWMM soil moisture depletion algorithm was not adequately reproducing the seasonality of soil moisture levels; soils were generally saturating during every storm and then drying out to the maximum moisture deficit within a few days. Thus, the model predicted that storms in February responded the same to rainfall as storms in November. The SWMM soil moisture depletion algorithm was therefore modified so that the depletion rate and storage capacity of the soil layer controlling infiltration could be adjusted during calibration. The depletion rate was defined as a fraction of the potential evapotranspiration rate:

$$R_i = (F_d)(PET_i) \tag{B-3}$$

where:

R_i = the soil moisture depletion rate for month i
PET_i = the potential evapotranspiration rate for month i
F_d = the soil moisture depletion factor

This modification allowed depletion rates to vary seasonally, and F_d was added as a calibration parameter for the model. To control the storage capacity of the soil, the thickness of the soil layer controlling infiltration was also added as a calibration parameter. This storage parameter could then be adjusted along with the depletion factor to match the observed seasonality in runoff.

B.2.2.8 Interflow Parameters. To model the interflow recession observed in many storm hydrographs in the Study Area, the SWMM groundwater model was configured as shown in Figure B-4. The bottom of the saturated zone was set at a relatively shallow depth (10 to 15 feet) so that the saturated zone rose rapidly during storm events and released stored water into channels within 1 to 7 days. This interflow system was modeled only in steep areas with high rainfall volumes; interflow was generally not observed in valley floor catchments.

Model input parameters in the unsaturated zone include storage parameters such as field capacity and wilting point, and parameters describing hydraulic conductivity as a function of soil moisture. These were generally estimated from tables of typical values for the appropriate SCS soil types. Similarly, the saturated zone is defined by storage parameters such as porosity and rate parameters such the saturated zone outflow coefficients. Flow from the saturated zone into the channel was calculated using the following model based on head differences between the channel and the saturated zone:

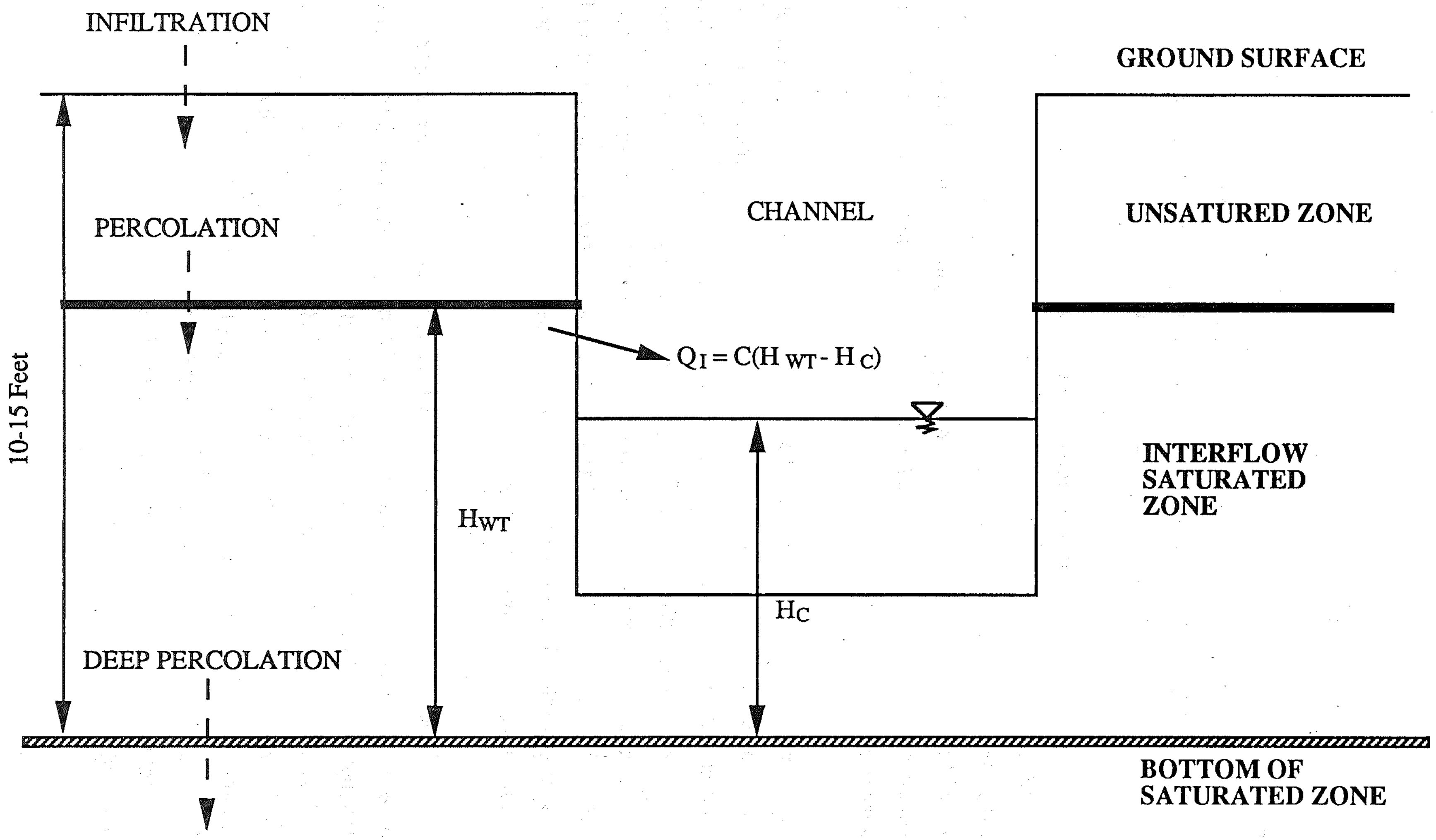


FIGURE B-4. SWMM Interflow Model

$$Q_I = C(H_{wt} - H_c) \tag{B-4}$$

where:

Q_I = interflow rate into the channel (cfs)
H_{wt} = elevation of the water table (ft)
H_c = elevation of water in the channel (ft)
C = interflow coefficient (ft^2/sec)

The interflow coefficient C is a calibration parameter which was primarily used to determine the magnitude of interflow into the channel. An additional calibration parameter, representing deep percolation out of the saturated zone, was used to steepen predicted hydrograph recessions to match observed recession curves.

B.2.2.9 Channel Data. Runoff and interflow from SWMM subcatchments were routed down channels using the SWMM non-linear routing algorithm. For this study, one channel was defined for each rain gage subarea, and input data were required specifying the slope, Manning's roughness coefficient, and cross section of each channel reach. Cross-sectional data for all streams were provided by the SCVWD in the form of HEC-2 input files used in flood modeling. From these, representative cross sections were selected and approximated as trapezoids for SWMM (defined by a bottom width and two side slopes). Manning's roughness coefficients and slopes were averaged for each channel reach modeled.

B.3 SWMM CALIBRATION AND VERIFICATION

Although SWMM is a state of the art model of rainfall-runoff processes, it, like all runoff models, represents an idealization of the actual processes occurring in a catchment. In addition, the spatial variability of model input parameters is difficult to account for in large catchments with many types of geology and land uses. Therefore, the model must be calibrated against measured streamflow data to produce reliable results. The calibration consists of running the model, comparing model prediction to measured streamflows, and adjusting the model calibration parameters to better match the observed flows. The process is repeated until the comparison between measured and predicted flows is deemed adequate. Calibration is then followed by verification, in which the calibrated model is run and compared to streamflow records for a period not included in the calibration period.

The following sections describe 1) calibration criteria, 2) selection of calibration periods, 3) calibration parameters, and 4) results for individual watersheds.

B.3.1 Calibration Goals and Criteria

To capture the year to year variability of runoff, SWMM was run continuously over several years during calibration and verification. Since the emphasis of this study was on annual loads from storm runoff, the primary goal of calibration was to match measured wet-season total runoff volumes. The runoff volume for a season consists primarily of runoff from relatively few storm events (typically less than 15), and matching wet-season runoff volumes required accurate simulation of individual storm events.

For calibration purposes, predicted flows were compared to measured flows at SCVWD and USGS stream gages. See Section 5.2 for a discussion of stream gages in the Study Area. A number of parameters were calculated to measure the quality of calibration. For comparing predicted versus measured wet-season totals, the following statistics were calculated:

$$\text{RMSE} = \frac{100\left(\sum_{i=1}^{n}(P_i - M_i)^2/n\right)^{\frac{1}{2}}}{M} \qquad \text{(B-5)}$$

$$\text{BIAS} = 100(P - M)/M \qquad \text{(B-6)}$$

where:

P_i = predicted wet-season runoff volume for year i (in.)
M_i = measured wet-season runoff volume for year i (in.)
n = the number of years in the calibration period.
M = the mean measured wet-season runoff volume (in.)
P = the mean predicted wet-season runoff volume (in.)

The RMSE, or root mean square error, is a measure of the absolute magnitude of calibration errors expressed as a percentage of mean runoff. The BIAS indicates whether the model is on average over- or under-predicting runoff volumes, and is also expressed as a percentage of the mean wet-season runoff volume. The goal of calibration was to minimize both the RMSE and the BIAS.

Results of calibrations performed for comparable studies were consulted to derive specific calibration acceptance criteria. Alley (1986) summarizes calibration results from the USGS rainfall-runoff model DR3M for 37 catchments nationwide. In this study, calibration errors were measured by the mean absolute deviation (MAD) between predicted and observed flow volumes. On average, the MAD was on the order of 20 percent for the 37 simulated catchments. In a modeling study of three small urban catchments, Guay and Smith (1988) calibrated the USGS model DR3M to runoff data for 10 to 13 storms in one season. Prediction errors in total annual runoff volume for these three single land use catchments ranged from 10 to 25 percent. In a study performed on Permanente Creek in Santa Clara County, Nolan and Hill (1989) obtained calibration errors in total annual flow volume of 3 to 33 percent.

These studies indicate that calibration errors are generally on the order of 20 percent, but may range as high as 30 or 40 percent. The studies cited above generally focused on small (less than 100 acre) urban catchments with a single well-defined land use. None of these studies calibrated using more than 3 years of flow data. Thus, one would expect that the calibration errors obtained in modeling the large watersheds in the Santa Clara Valley for up to 10 years of flow data would be somewhat higher. Nonetheless, for this study a relatively ambitious calibration goal of 15 percent RMSE was used for annual flow predictions. Given the difficulties inherent in simulating large open areas, this goal was often not achieved. However, the RMSEs summarized in Table B-3 range from 1 to 40 percent, and are consistent with calibration errors obtained in other studies. More importantly, the biases in the model predictions are small, and range from 1 to 16 percent.

Daily predicted flows were compared to measured flows in two ways. First, daily predicted flows and measured flows were plotted together over time and visually compared. These plots were used for detailed analyses of the sources of calibration errors, particularly in terms of matching seasonal runoff patterns and hydrograph recessions. Finally, a Kolmogorov-Smirnov hypothesis test was used to compare the frequency distributions of measured and predicted daily flows. This test first calculates the maximum difference between measured and predicted cumulative probabilities. This difference is then compared to a test statistic based on the number of daily flows and the confidence level. If the maximum difference is less than the test statistic, the hypothesis that the predicted and measured flows are from the same population is accepted. This test, while it does not check that the flow on a given day is accurately predicted, does measure how well the model is reproducing the day to day variability of flows.

B.3.2 Selection of Calibration and Verification Periods

Runoff in the Study Area varies greatly from year to year, and the annual runoff volume for a wet year can be ten times greater than in a dry year. A calibration based on only one dry year would therefore not accurately represent runoff in wet years. Therefore, SWMM was calibrated and verified against as many years of streamflow data as were available, Table B-3. SUMMARY OF SWMM CALIBRATION/VERIFICATION

Watershed	Calibration Period	Verification Period	Calibration			Verification			Combined Calibration and Verification Period		
			Mean Wet-Season Runoff (in.)	RMSE (%)	Bias (%)	Mean Wet-Season Runoff (in.)	RMSE (%)	Bias (%)	Mean Wet-Season Runoff (in.)	RMSE[a] (%)	Bias[b] (%)
Calabazas Creek	1976-80, 86-88	1980-83, 1984-85, 1988-1989	4.08	8	-5	5.51	13	6	4.73	11	1
Stevens Creek	1977-1981	1975-77, 1981-83	1.96	15	1	2.15	45	1	2.06	34	1
Sunnyvale East	1974-1982	1984-1989	5.66	6	3	3.31	3	-9	4.59	9	-1
Saratoga Creek	1974-1982	1982-1986	6.57	30	-8	11.98	13	10	8.19	22	0.1
San Tomas Aquinas Creek	1975-1981	1983-1987	6.58	17	-7	6.93	25	5	6.73	21	-2
Coyote Creek	1988-1989	None	0.73	1	-1	None	None	None	0.73	1	-1
Berryessa Creek	1974-1979	1980-1982	1.39	19	-12	4.69	25	16	2.49	29	6
Guadalupe River	1977-1981	1981-82, 1987-89	2.92	38	-2	1.73	40	-3	2.4	40	-2
STUDY AREA			2.80	25	-4	2.98	22	5	2.8	25	-1

---

[a] RMSE measures the average error in predicted wet-season runoff, as a percentage of the mean wet-season runoff volume.

[b] BIAS measures the average bias (tendency to under- or over-predict) in predicted wet-season runoff, as a percentage of the mean wet-season runoff volume.

with approximately two thirds of the record used for calibration and one third for verification. As discussed in Section 5.0, concurrent streamflow and rainfall data are generally available for the period 1974 through 1989, with occasional gaps due to gaging errors, data storage problems, and damage to stream gages. Table B-3 summarizes the calibration and verification periods for the various watersheds; calibration periods were typically 4 to 9 years in length, while verification periods were 3 to 5 years long. Both calibration and verification periods were selected to contain a mix of wet, dry, and average years. Note that there was only one year of data available for calibration of the Coyote Creek watershed.

B.3.3 Calibration Parameters

Table B-4 summarizes the values of parameters derived from calibration of SWMM for each watershed. For adjustment of runoff volumes in urban areas, the most important parameters were the percent of impervious area and depression storages. These parameters were especially important in dry years when almost all runoff was from impervious areas; the percent impervious area for each of the various land uses was therefore determined primarily through calibration on dry years. In open and low-residential areas, the most important parameters were the Green-Ampt infiltration and soil depletion parameters. The saturated hydraulic conductivity was used to determine the overall rate of infiltration (and therefore reduction in runoff). The soil moisture depletion parameters L and F_d were used to model the seasonality of infiltration (and runoff) by adjusting the rate at which soils dried out between storms. The interflow coefficient A1 and deep percolation factor DF were used to match hydrograph recessions, while CET, POR, and GRELEV defined the storage characteristics of the saturated zone.

B.3.3.1 Calibration of the Percent Imperviousness. One of the most sensitive model parameters in urban areas is the percent imperviousness. Runoff volumes are often directly proportional to the value of the percent imperviousness, meaning that if this parameter is doubled, runoff volumes

Table B-4. PARAMETER VALUES USED IN THE CALIBRATION OF SWMM FOR EACH WATERSHED

Watershed	Sub Catchment	Rain Gage	Land Use Type	Area (acre)	% Imp.	Manning's n		Depression Storage		Infiltration Parameters		Initial Moist. Deficit	Soil Moist. Depletion Factor	Infil. Layer Thickness (in.)
						Imp.	Perv.	Imp. (in.)	Perv. (in.)	Suction Pres. (in.)	Hyd. Con. (in./hr)			
Coyote	Upper Penitentia	99	Open	142.4	0	0.013	0.4	0.03	0.1	10	0.05	0.26	0.8	20
			Med. Res.	849.3	25	0.013	0.4	0.03	0.1	10	0.1	0.26	0.8	20
			High Res.	173.8	35	0.013	0.2	0.03	0.1	10	0.1	0.26	0.8	20
			Comm.	31.4	45	0.013	0.2	0.03	0.1	10	0.1	0.26	0.8	20
	Silver Thompson	98	Open	18559	0	0.013	0.4	0.03	0.1	10	0.05	0.26	0.8	20
			Low Res.	4432	15	0.013	0.2	0.03	0.1	10	0.1	0.26	0.8	20
			Med. Res.	4709	25	0.013	0.2	0.03	0.1	10	0.1	0.26	0.8	20
		86	Open	5201	0	0.013	0.4	0.03	0.1	10	0.1	0.26	0.8	20
			Med. Res.	4186	25	0.013	0.2	0.03	0.1	10	0.1	0.26	0.8	20
			High Res.	254	35	0.013	0.2	0.03	0.1	10	0.1	0.26	0.8	20
			Comm.	1903	60	0.013	0.2	0.03	0.1	10	0.1	0.26	0.8	20
			Industrial	1142	70	0.013	0.2	0.03	0.1	10	0.1	0.26	0.8	20
	Berryessa	323	Open	17860	0	0.013	0.2	0.03	0.1	10	0.16	0.26	0.2	7
			Low Res.	952	10	0.013	0.2	0.03	0.1	10	0.16	0.26	0.2	7
			Med. Res.	1452	20	0.013	0.2	0.03	0.1	10	0.16	0.26	0.2	7
			Comm.	541	40	0.013	0.2	0.03	0.1	10	0.16	0.26	0.2	7
			Industrial	465	50	0.013	0.2	0.03	0.1	10	0.16	0.26	0.2	7
		123	Low Res.	283.2	5	0.013	0.2	0.03	0.1	10	0.16	0.26	0.2	7
			Med. Res.	1529.3	13	0.013	0.2	0.03	0.1	10	0.16	0.26	0.2	7
		223	Open	2163.5	0	0.013	0.24	0.03	0.1	10	0.08	0.26	0.2	7
			Low Res.	961.5	5	0.013	0.2	0.03	0.1	10	0.16	0.26	0.2	7
			Med. Res.	80.1	20	0.013	0.2	0.03	0.1	10	0.16	0.26	0.2	7
			High Res.	40.1	30	0.013	0.2	0.03	0.1	10	0.16	0.26	0.2	7
San Tomas	79	79	Open	1479	0	0.03	0.4	0.03	0.1	10	0.1	0.26	0.4	10
			Low Res.	5100	10	0.03	0.2	0.03	0.1	10	0.1	0.26	0.4	10
			Med. Res.	739	20	0.03	0.2	0.03	0.1	10	0.1	0.26	0.4	10
			Comm.	74	50	0.03	0.2	0.03	0.1	10	0.1	0.26	0.4	10
	108	108	Open	331	0	0.03	0.2	0.05	0.15	10	0.2	0.26	0.4	10
			Low Res.	3526	10	0.03	0.2	0.05	0.15	10	0.2	0.26	0.4	10
			Med. Res.	662	20	0.03	0.2	0.05	0.15	10	0.2	0.26	0.4	10
			High Res.	551	30	0.03	0.2	0.05	0.15	10	0.2	0.26	0.4	10
			Comm.	441	40	0.03	0.2	0.05	0.15	10	0.2	0.26	0.4	10
	86	86	Low Res.	1820	10	0.03	0.2	0.05	0.15	10	0.2	0.26	0.4	10
			Med. Res.	373	20	0.03	0.2	0.05	0.15	10	0.2	0.26	0.4	10
			Industrial	2473	60	0.03	0.2	0.05	0.15	10	0.2	0.26	0.4	10

Table B-4. PARAMETER VALUES USED IN THE CALIBRATION OF SWMM FOR EACH WATERSHED (continued)

Watershed	Sub Catchment	Rain Gage	Land Use Type	Area (acre)	% Imp.	Manning's n		Depression Storage		Infiltration Parameters		Initial Moist. Deficit	Soil Moist. Depletion Factor	Infil. Layer Thickness (in.)
						Imp.	Perv.	Imp. (in.)	Perv. (in.)	Suction Pres. (in.)	Hyd. Con. (in./hr)			
Saratoga	77	77	Open	5535	0	0.013	0.4	0.1	0.3	10	0.1	0.26	0.2	7
			Low Res.	554	3	0.013	0.2	0.1	0.3	10	0.1	0.26	0.2	7
	108	108	Open	199	0	0.013	0.2	0.1	0.3	10	0.3	0.26	0.2	7
			Low Res.	1755	5	0.013	0.2	0.1	0.3	10	0.3	0.26	0.2	7
			Med. Res.	2443	8	0.013	0.2	0.1	0.3	10	0.3	0.26	0.2	7
			High Res.	69	30	0.013	0.2	0.1	0.3	10	0.3	0.26	0.2	7
			Comm.	482	20	0.013	0.2	0.1	0.3	10	0.3	0.26	0.2	7
Sunnyvale East Channel	48	48	Low Res.	2048	10	0.013	0.2	0.03	0.1	9	0.12	0.26	0.7	7
			Med. Res.	637	20	0.013	0.2	0.03	0.1	9	0.12	0.26	0.7	7
			High Res.	106	30	0.013	0.2	0.03	0.1	9	0.12	0.26	0.7	7
			Comm.	1632	60	0.013	0.2	0.03	0.1	9	0.12	0.26	0.7	7
Guadalupe	Calero	228	Open	2057	0	0.013	0.4	0.2	0.3	8	0.05	0.25	0.8	10
			Low Res.	1316	5	0.013	0.2	0.2	0.3	8	0.05	0.25	0.8	10
	Alamitos	128	Open	1689	0	0.013	0.4	0.2	0.3	8.8	0.05	0.29	0.8	10
			Low Res.	909	5	0.013	0.2	0.06	0.2	8.8	0.05	0.29	0.8	10
		123	Open	4313	0	0.013	0.4	0.2	0.3	9	0.05	0.29	0.8	10
		401	Open	2259	0	0.013	0.4	0.1	0.3	8	0.05	0.25	0.8	15
			Low Res.	3175	5	0.013	0.2	0.03	0.2	8	0.05	0.25	0.8	15
			Med. Res.	672	15	0.013	0.2	0.03	0.2	8	0.05	0.25	0.8	15
		301	Open	566	0	0.013	0.4	0.1	0.3	7.4	0.12	0.25	0.8	15
			Low Res.	848	5	0.013	0.2	0.03	0.2	7.4	0.12	0.25	0.8	15
		201	Low Res.	347	5	0.013	0.2	0.03	0.2	8	0.12	0.3	0.8	14
			Med. Res.	3124	15	0.013	0.2	0.03	0.2	8	0.12	0.3	0.8	14
			High Res.	347	30	0.013	0.2	0.03	0.2	8	0.12	0.3	0.8	14
			Comm.	521	50	0.013	0.1	0.03	0.2	8	0.12	0.3	0.8	14
		86	Open	1538	0	0.013	0.2	0.03	0.2	8.3	0.12	0.29	0.8	14
			Low Res.	1878	5	0.013	0.2	0.03	0.2	8.3	0.12	0.29	0.8	14
			Med. Res.	4951	15	0.013	0.2	0.03	0.2	8.3	0.12	0.29	0.8	14
			High Res.	1194	30	0.013	0.2	0.03	0.2	8.3	0.12	0.29	0.8	14
			Comm.	4440	50	0.013	0.1	0.03	0.2	8.3	0.12	0.29	0.8	14
			Industrial	3072	60	0.013	0.1	0.03	0.2	8.3	0.12	0.29	0.8	14
	Canoas	401	Open	2504	0	0.013	0.2	0.03	0.2	7.6	0.12	0.26	0.8	14
			Low Res.	477	5	0.013	0.2	0.03	0.2	7.6	0.12	0.26	0.8	14
			Med. Res.	6200	15	0.013	0.2	0.03	0.2	7.6	0.12	0.26	0.8	14
			High Res.	715	30	0.013	0.2	0.03	0.2	7.6	0.12	0.26	0.8	14
			Comm.	596	50	0.013	0.1	0.03	0.2	7.6	0.12	0.26	0.8	14
			Industrial	1431	60	0.013	0.1	0.03	0.2	7.6	0.12	0.26	0.8	14

Table B-4. PARAMETER VALUES USED IN THE CALIBRATION OF SWMM FOR EACH WATERSHED (continued)

Watershed	Sub Catchment	Rain Gage	Land Use Type	Area (acre)	% Imp.	Manning's n		Depression Storage		Infiltration Parameters		Initial Moist. Deficit	Soil Moist. Depletion Factor	Infil. Layer Thickness (in.)
						Imp.	Perv.	Imp. (in.)	Perv. (in.)	Suction Pres. (in.)	Hyd. Con. (in./hr)			
Guadalupe	Ross	136	Open	1525	0	0.013	0.4	0.1	0.3	8.1	0.12	0.26	0.8	14
			Low Res.	1462	5	0.013	0.2	0.03	0.2	8.1	0.12	0.26	0.8	14
			Med. Res.	2923	15	0.013	0.2	0.03	0.2	8.1	0.12	0.26	0.8	14
			High Res.	254	30	0.013	0.2	0.03	0.2	8.1	0.12	0.26	0.8	14
			Comm.	191	50	0.013	0.1	0.03	0.2	8.1	0.12	0.26	0.8	14
	Los Gatos	125	Low Res.	2625	5	0.013	0.2	0.03	0.2	10	0.12	0.26	0.8	14
			Med. Res.	3000	15	0.013	0.2	0.03	0.2	10	0.12	0.26	0.8	14
			High Res.	600	30	0.013	0.2	0.03	0.2	10	0.12	0.26	0.8	14
			Comm.	1275	50	0.013	0.1	0.03	0.2	10	0.12	0.26	0.8	14
		36	Open	1935	0	0.013	0.4	0.1	0.3	10	0.12	0.26	0.8	10
			Low Res.	1290	5	0.013	0.2	0.06	0.2	10	0.12	0.26	0.8	10
			Med. Res.	645	15	0.013	0.2	0.03	0.2	10	0.12	0.26	0.8	10
			Comm.	161	50	0.013	0.1	0.03	0.2	10	0.12	0.26	0.8	10
Calabazas	100	100	Open	1965	0	0.013	0.4	0.1	0.3	9.1	0.03	0.24	0.8	10
			Low Res.	2158	6	0.013	0.2	0.1	0.3	9.1	0.025	0.24	0.8	10
			Med. Res.	457	15	0.013	0.2	0.1	0.3	9.1	0.025	0.24	0.8	10
	108	108	Low Res.	1133	10	0.013	0.2	0.06	0.1	7.9	0.025	0.3	0.6	7
			Med. Res.	2528	20	0.013	0.2	0.06	0.1	7.9	0.025	0.3	0.6	7
			Comm.	697	70	0.013	0.1	0.06	0.1	7.9	0.025	0.3	0.6	7
	121	121	Open	236	0	0.013	0.13	0.06	0.1	9.4	0.025	0.28	0.6	6
			Low Res.	1650	10	0.013	0.2	0.06	0.1	9.4	0.025	0.28	0.6	6
			Med. Res.	1083	20	0.013	0.2	0.06	0.1	9.4	0.025	0.28	0.6	6
			High Res.	330	30	0.013	0.2	0.06	0.1	9.4	0.025	0.28	0.6	6
			Comm.	1413	80	0.013	0.1	0.06	0.1	9.4	0.025	0.28	0.6	6
Stevens	100	100	Open	1022	0	0.013	0.4	0.1	0.3	10	0.07	0.28	0.8	10
			Low Res.	1250	6	0.013	0.2	0.1	0.3	10	0.07	0.28	0.8	10
	48	48	Low Res.	3068	8	0.013	0.2	0.06	0.1	10	0.1	0.28	0.7	8
			Med. Res.	98	20	0.013	0.2	0.06	0.1	10	0.1	0.28	0.7	8
			Comm.	98	50	0.013	0.1	0.06	0.1	10	0.1	0.28	0.7	8
	121	121	Open	44	0	0.013	0.16	0.06	0.1	10	0.1	0.28	0.7	8
			Low Res.	256	8	0.013	0.2	0.06	0.1	10	0.1	0.28	0.7	8
			Med. Res.	222	20	0.013	0.2	0.06	0.1	10	0.1	0.28	0.7	8
			High Res.	200	30	0.013	0.2	0.06	0.1	10	0.1	0.28	0.7	8
			Comm.	389	80	0.013	0.1	0.06	0.1	10	0.1	0.28	0.7	8

Table B-4. PARAMETER VALUES USED IN THE CALIBRATION OF SWMM FOR EACH WATERSHED (continued)

Watershed	Sub Catchment	Rain Gage	Land Use Type	Area (acre)	% Imp.	Manning's n		Depression Storage		Infiltration Parameters		Initial Moist. Deficit	Soil Moist. Depletion Factor	Infil. Layer Thickness (in.)
						Imp.	Perv.	Imp. (in.)	Perv. (in.)	Suction Pres. (in.)	Hyd. Con. (in./hr)			
Sunnyvale West	48	48	Open	100	0	0.013	0.2	0.03	0.1	9	0.1	0.26	0.7	7
			Low Res.	451	10	0.013	0.2	0.03	0.1	9	0.1	0.26	0.7	7
			Med. Res.	511	20	0.013	0.2	0.03	0.1	9	0.1	0.26	0.7	7
			High Res.	165	30	0.013	0.1	0.03	0.1	9	0.1	0.26	0.7	7
			Comm.	33	60	0.013	0.1	0.03	0.1	9	0.1	0.26	0.7	7
San Francisquito	24	24	Open	2339	0	0.013	0.2	0.1	0.3	9	0.07	0.26	0.8	10
			Low Res.	349	6	0.013	0.2	0.1	0.3	9	0.07	0.26	0.8	10
	53	53	Open	1425	0	0.013	0.2	0.1	0.3	9	0.07	0.26	0.8	10
			Low Res.	483	8	0.013	0.2	0.1	0.3	9	0.07	0.26	0.8	10
			Med. Res.	45	20	0.013	0.2	0.08	0.2	9	0.07	0.26	0.8	10
			Comm.	345	50	0.013	0.1	0.08	0.1	9	0.07	0.26	0.8	10
Adobe	24	24	Open	2546	0	0.013	0.2	0.1	0.3	9	0.07	0.26	0.8	10
			Low Res.	315	6	0.013	0.2	0.1	0.3	9	0.07	0.26	0.8	10
	53	53	Open	557	0	0.013	0.2	0.08	0.1	9	0.05	0.26	0.6	7
			Low Res.	6192	8	0.013	0.2	0.08	0.1	9	0.05	0.26	0.6	7
			Comm.	209	50	0.013	0.1	0.08	0.1	9	0.05	0.26	0.6	7
	48	48	Low Res.	753	8	0.013	0.2	0.08	0.1	9	0.05	0.26	0.6	7
			Comm.	502	50	0.013	0.1	0.08	0.1	9	0.05	0.26	0.6	7
Barron	53	53	Open	48	0	0.013	0.2	0.08	0.1	9	0.05	0.26	0.6	7
			Low Res.	1450	6	0.013	0.2	0.1	0.3	9	0.07	0.26	0.8	10
			Med. Res.	48	20	0.013	0.2	0.08	0.1	9	0.05	0.26	0.6	7
			Comm.	48	50	0.013	0.1	0.08	0.1	9	0.05	0.26	0.6	7
	48	48	Low Res.	266	8	0.013	0.2	0.08	0.1	9	0.05	0.26	0.6	7
			Med. Res.	17	20	0.013	0.2	0.08	0.1	9	0.05	0.26	0.6	7
			Comm.	50	50	0.013	0.1	0.08	0.1	9	0.05	0.26	0.6	7
Matadero	53	53	Open	1933	0	0.013	0.2	0.1	0.3	9	0.07	0.26	0.8	10
			Low Res.	1933	6	0.013	0.2	0.1	0.3	9	0.07	0.26	0.8	10
			Med. Res.	145	15	0.013	0.2	0.08	0.2	9	0.07	0.26	0.8	10
			Comm.	821	50	0.013	0.1	0.08	0.1	9	0.07	0.26	0.8	10
	48	48	Open	585	0	0.013	0.2	0.08	0.1	9	0.05	0.26	0.6	7
			Low Res.	2173	8	0.013	0.2	0.08	0.1	9	0.05	0.26	0.6	7
			Med. Res.	418	20	0.013	0.2	0.08	0.1	9	0.05	0.26	0.6	7
			Comm.	1003	50	0.013	0.1	0.08	0.1	9	0.05	0.26	0.6	7

Table B-4. PARAMETER VALUES USED IN THE CALIBRATION OF SWMM FOR EACH WATERSHED (concluded)

Watershed	Sub Catchment	Rain Gage	Land Use Type	Area (acre)	% Imp.	Manning's n		Depression Storage		Infiltration Parameters		Initial Moist. Deficit	Soil Moist. Depletion Factor	Infil. Layer Thickness (in.)
						Imp.	Perv.	Imp. (in.)	Perv. (in.)	Suction Pres. (in.)	Hyd. Con. (in./hr)			
Permanente	Hale	53	Open	323	0	0.013	0.4	0.1	0.3	9	0.07	0.26	0.8	10
			Low Res.	2204	6	0.013	0.2	0.1	0.3	9	0.07	0.26	0.8	10
			High Res.	108	30	0.013	0.2	0.08	0.1	9	0.07	0.26	0.8	10
			Comm.	54	50	0.013	0.1	0.08	0.1	9	0.07	0.26	0.8	10
	48	48	Open	290	0	0.013	0.4	0.1	0.3	9	0.05	0.26	0.6	7
			Low Res.	1101	8	0.013	0.2	0.08	0.1	9	0.05	0.26	0.6	7
			Comm.	58	50	0.013	0.1	0.08	0.1	9	0.05	0.26	0.6	7
	121	121	Open	150	0	0.013	0.2	0.08	0.1	9	0.05	0.26	0.6	7
			Low Res.	782	8	0.013	0.2	0.08	0.1	9	0.05	0.26	0.6	7
			Med. Res.	266	20	0.013	0.2	0.08	0.1	9	0.05	0.26	0.6	7
			High Res.	399	30	0.013	0.2	0.08	0.1	9	0.05	0.26	0.6	7
			Comm.	67	80	0.013	0.1	0.08	0.1	9	0.05	0.26	0.6	7

will nearly double. This is especially true in urban areas with low rainfall intensities.

Estimation of the percent imperviousness can conceivably be performed by direct measurement from areal photographs. However, this is usually impractical for large areas such as the Santa Clara Valley. The usual practice is therefore to derive general values of this parameter for each land use category. However, even values tabulated in the literature for individual land uses may vary by as much as 100 percent. For instance, Table B-5 compares values tabulated for Santa Clara County by (1) the SCVWD, and (2) the U.S. Geological Survey (1977). In general, the USGS values are considerably lower than the SCVWD values. The USGS data also indicate considerable variability within land use categories, with values ranging from 6 percent in hillside residential areas to 10 percent in valley floor low-density residential areas. An important conclusion that can be drawn from this is that no one value can be realistically used to represent all low-density residential areas, since not all areas within the low-density category are paved or developed to the same extent.

For our calibration of SWMM, we initially used the percent imperviousness values developed by the SCVWD (shown in Table B-5). However, use of these values resulted in consistent overestimation of runoff. That this overestimation was derived from the imperviousness estimate became apparent when examining predicted runoff from small early season storms. Runoff from these storms comes primarily from paved areas, and the model consistently overpredicted runoff from these storms even when infiltration parameters were adjusted to prevent any pervious area runoff from occurring. We therefore adjusted the percent impervious values downward to match storm volumes for these types of events.

Clearly, percent imperviousness is a very sensitive calibration parameter, and should not be adjusted to account for processes that may be better represented by the pervious area infiltration parameters. To ensure

Table B-5. COMPARISON OF CALIBRATED PERCENT IMPERVIOUSNESS VALUES TO VALUES SUPPLIED BY SCVWD

Land Use	SCVWD Percent Imperviousness	USGS (1977) Percent Imperviousness*	Calibrated Percent Imperviousness
Open	0	2	0
Low Residential	35	6, Hillsides 10, Valley Floor	3-10, Hillsides 8-10, Valley Floor 10-15, Eastern Valley Floor
Medium Residential	65	20	15-25
High Residential	75	32	30-35
Commercial	90	50	50-80
Industrial	90	40-50	50-70

* Values tabluated for Santa Clara County.

that we were not adjusting percent imperviousness when calibration of infiltration parameters would have been more appropriate, calibration of this parameter was performed only to match runoff volumes from small storms where little runoff was occurring from pervious areas. The resulting calibrated percent imperviousness values are shown in Table B-4 for each watershed, and are summarized in Table B-5. As shown in Table B-5, the calibrated values are much lower than the original SCVWD values, but are consistent with percent imperviousness values tabulated by the USGS for Santa Clara County.

B.3.3.2 Sensitivity of the Model to Green-Ampt Infiltration Parameters. An important component of the SWMM rainfall-runoff calibration was the calibration of the Green-Ampt infiltration parameters. These parameters control infiltration of water on pervious surfaces, and thus play a critical role in predicting runoff from open areas. The Green-Ampt infiltration algorithm has three parameters: the saturated hydraulic conductivity, a capillary suction parameter, and the maximum soil moisture deficit. Sensitivity analyses of the model indicated that the controlling infiltration parameter was the saturated hydraulic conductivity, defined as the infiltration rate at saturation. Our calibration efforts therefore focused on this parameter, while leaving the values of the suction parameter and soil moisture deficit constant. As a result, occasionally the final calibrated value of the hydraulic conductivity was not consistent with the values of the suction parameter and maximum soil moisture deficit.

To test whether this inconsistency had a significant effect on the model results, a model run for Calabazas Creek was performed to demonstrate SWMM's insensitivity to the suction parameter and maximum soil moisture deficit. In this run, the values of these two parameters (which formerly corresponded to a moderately permeable "C" soil) were forced to be consistent with the calibrated hydraulic conductivity value (which corresponded to a low permeability "D" soil). Table B-6 summarizes the results of this analysis. In general, annual flow volumes were insensitive

Table B-6. SENSITIVITY OF ANNUAL LOADINGS TO THE SUCTION AND INITIAL MOISTURE DEFICIT PARAMETERS

	Percent Difference from Original Model Results		
Year	Mixed	Open	Total
77-78	-3.29	-0.87	-3.00
78-79	-4.55	-2.21	-4.24
79-80	-4.14	-2.61	-3.93
80-81	-1.00	-0.65	-0.95
81-82	-2.17	-0.81	-1.99
82-83	-3.70	-1.40	-3.39
83-84	-3.70	-2.91	-3.61
84-85	-1.54	-4.33	-1.67
85-86	-2.09	-1.78	-2.06
86-87	-1.10	-2.80	-1.15
87-88	-0.98	-0.65	-0.96
88-89	0.00	-8.39	-0.02
Total	-2.93	-1.60	-2.78

to these parameters. Annual loading results between the new run and the original run differed by as little as .02 percent in 1988-89, and by as much as 4 percent in 1978-79. Total loadings for the 1977-1989 period change by about 3 percent.

B.3.3.3 Sensitivity of the Model to Time Series Potential Evapotranspiration Data. Potential evapotranspiration (PE) was represented in the model by average pan evaporation rates for each month of the year. Evaporation data are used in the model to simulate (1) changes in depression storage between storms and (2) seasonal changes in soil moisture storages. These processes primarily affect the antecedent soil moisture levels before storms, and therefore are most important in nonurban areas. Soil moisture levels change on a monthly or seasonal time scale, indicating that predicted annual runoff volumes are not sensitive to day to day changes in evaporation rates.

Table B-7 summarizes the mean monthly evaporation rates used in the model, and also shows the standard deviation and range of observed monthly values for the period 1976 to 1988. Note that the standard deviation of monthly values is on the order of 20 percent or less of the mean, indicating that monthly evaporation shows little year to year variation. To test the sensitivity of the annual loading predictions to the use of monthly average PE data, a model simulation was performed for Calabazas Creek using time series PE data. Table B-8 compares the resulting flow predictions to those obtained using monthly average evaporation data. Annual loads predicted from the two data sets differed by 1 to 6 percent, while the mean annual load differed by only 1.6 percent. Thus, it is reasonable to conclude that monthly average PE data are adequate for annual loads prediction.

B.3.4 Calibration and Verification Results

Table B-3 summarizes the calibration and verification statistics for all of the watersheds for which flow data were available. Figures B-5

Table B-7. MONTHLY AVERAGE POTENTIAL EVAPOTRANSPIRATION VALUES USED IN FLOW CALIBRATION

Month	Mean Evaporation (in.)	Standard Deviation (in.)	Range (in.)
October	2.93	.30	2.4 - 3.4
November	1.36	.26	0.8 - 1.8
December	0.79	.17	0.6 - 1.1
January	0.79	.13	0.6 - 1.0
February	1.45	.27	1.0 - 1.8
March	2.35	.53	1.9 - 3.3
April	3.95	.51	3.2 - 4.3
May	5.25	.73	4.3 - 6.7
June	6.69	.65	5.8 - 8.0
July	7.02	.88	6.0 - 9.0
August	5.96	.53	4.8 - 6.8
September	4.48	.83	3.0 - 6.1

Table B-8. SENSITIVITY OF ANNUAL FLOW PREDICTIONS TO THE USE OF AVERAGE VS TIME SERIES POTENTIAL EVAPOTRANSPIRATION DATA

	% Difference In Annual Flow Volume		
Year	Mixed Land Use	Open Land Use	Total
77-78	1.5	0.9	1.4
78-79	3.9	7.0	4.3
79-80	0.6	2.6	0.9
80-81	0.5	0.7	0.5
81-82	1.6	1.6	1.6
82-83	0.7	-0.5	0.6
83-84	2.6	4.8	2.9
84-85	4.6	23.7	5.5
85-86	2.1	3.1	2.2
86-87	1.1	2.8	1.1
TOTAL	1.6	2.0	1.6

through B-11 plot predicted wet-season volumes against measured volumes. These statistics and plots measure how well the model was able to predict total wet-season runoff volumes. During calibration, RMSEs ranged from 1 to 38 percent, and the BIAS ranged from ±1 to ±12 percent. During verification, RMSEs ranged from 3 to 45 percent, and the BIAS ranged from ±1 to ±16 percent. For the combined period, RMSEs ranged from 1 to 40 percent of mean wet-season runoff, while the BIAS ranged from ±0.1 to ±6 percent. The flow-weighted average RMSEs for the Study Area were 25, 22, and 25 percent for the calibration, verification, and combined periods, respectively. Average BIASes were -4, 5, and -1 percent for these three periods. Details on the calibration and verification process for individual watersheds are presented below.

B.3.4.1 Calabazas Creek. Calabazas Creek originates in the foothills of the Santa Cruz Mountains and drains into Guadalupe Slough. Mean annual rainfall ranges from 12 inches near the Bay to 32 inches in the foothills. For SWMM, the catchment was divided into three rain gage subareas corresponding to SCVWD rain gages 100, 108, and 121. Model calibration was performed primarily against streamflow data for SCVWD streamgage 26a, located on the valley floor and representing about three-fourths of the total watershed area. In addition, streamflow data at SCVWD streamgage 31 were used to refine estimates of pervious runoff parameters in the upper portion of the watershed.

Calibration and verification results for Calabazas Creek, in terms of wet-season runoff, are illustrated in Figure B-5. The calibration for Calabazas Creek was generally accurate and unbiased, with a RMSE for the combined calibration/verification period of 11 percent of the mean volume and a BIAS of 1 percent. The predicted daily flow distribution passed the Kolmogorov-Smirnov distribution test at the 95 percent confidence level. The most important calibration parameters were the Green-Ampt infiltration parameters, used to model seasonal runoff. Matching the seasonal patterns of runoff required an infiltration layer with a thickness of 8 to 10

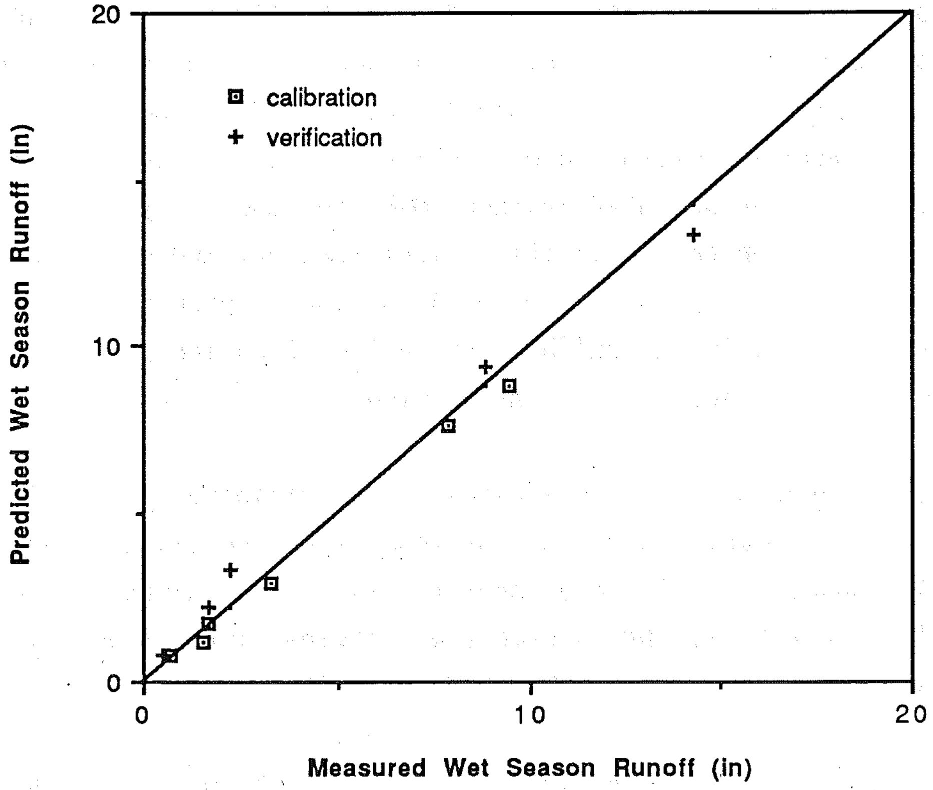


Figure B-5. Predicted versus Measured Wet Season Runoff for Calabazas Creek

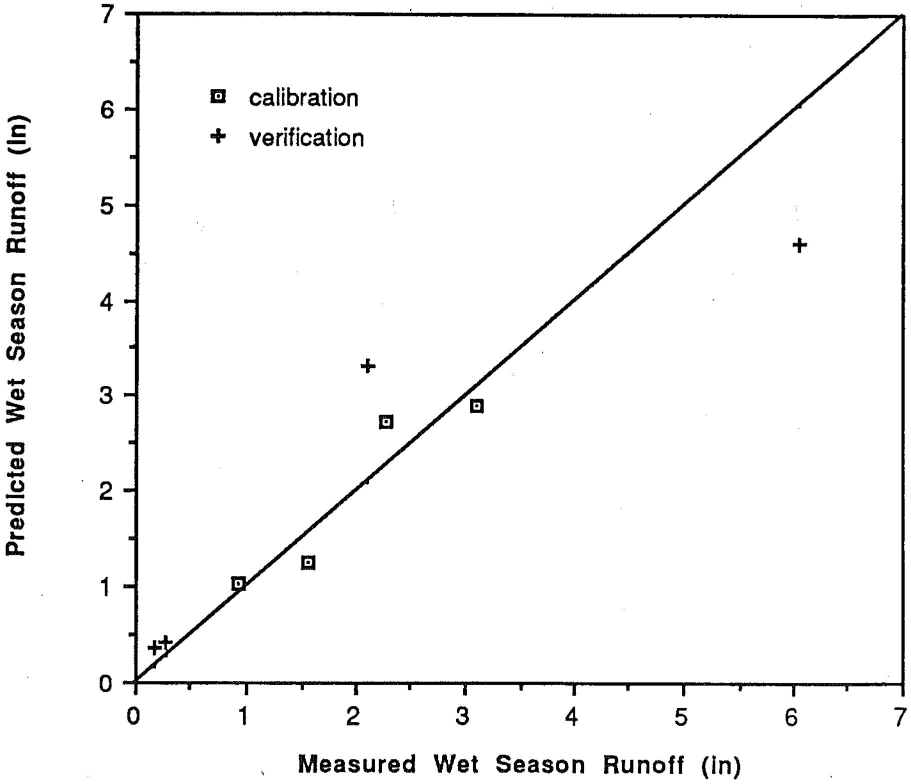


Figure B-6. Predicted versus Measured Wet Season Runoff for Stevens Creek

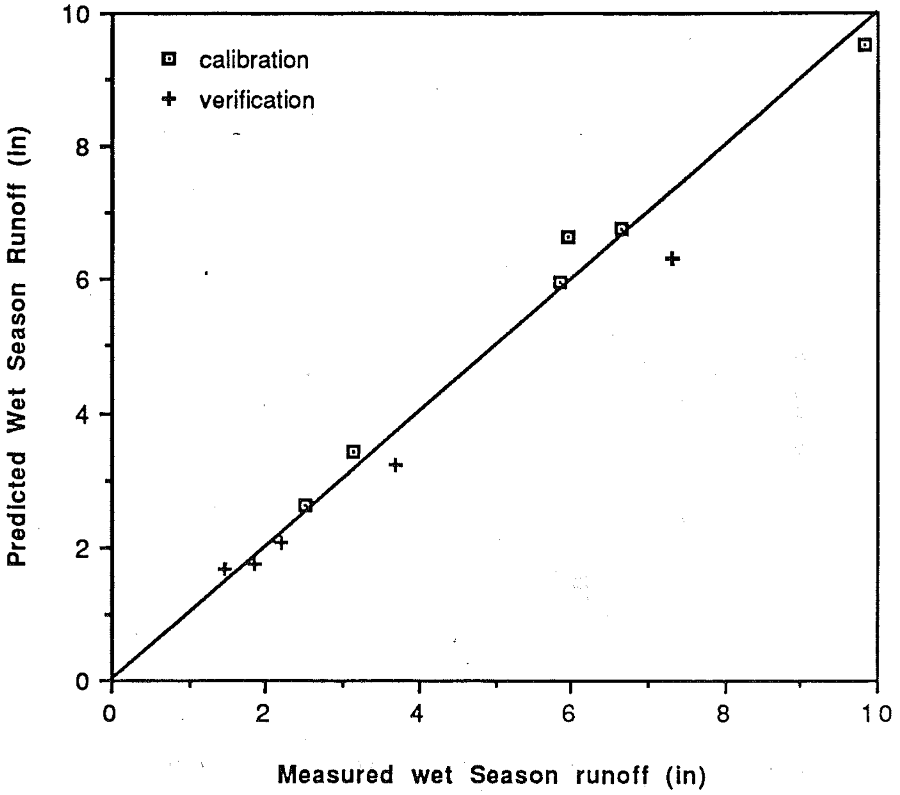


Figure B-7. Predicted versus Measured Wet Season Runoff for Sunnyvale East Channel

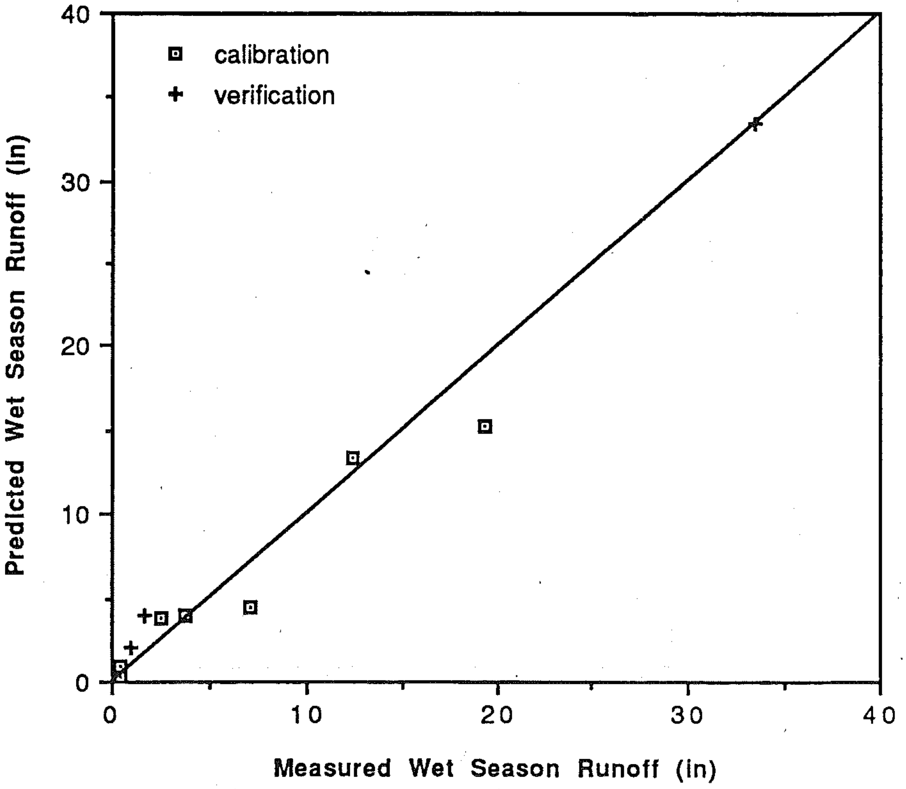


Figure B-8. Predicted versus Measured Wet Season Runoff for Saratoga Creek

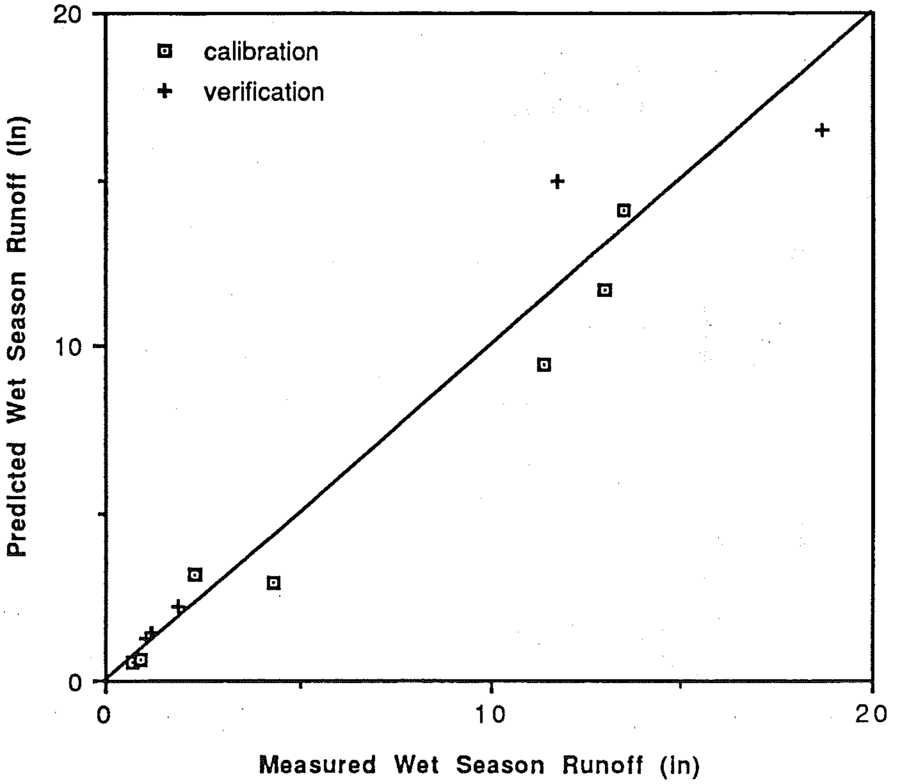


Figure B-9. Predicted versus Measured Wet Season Runoff for San Tomas Aquinas Creek

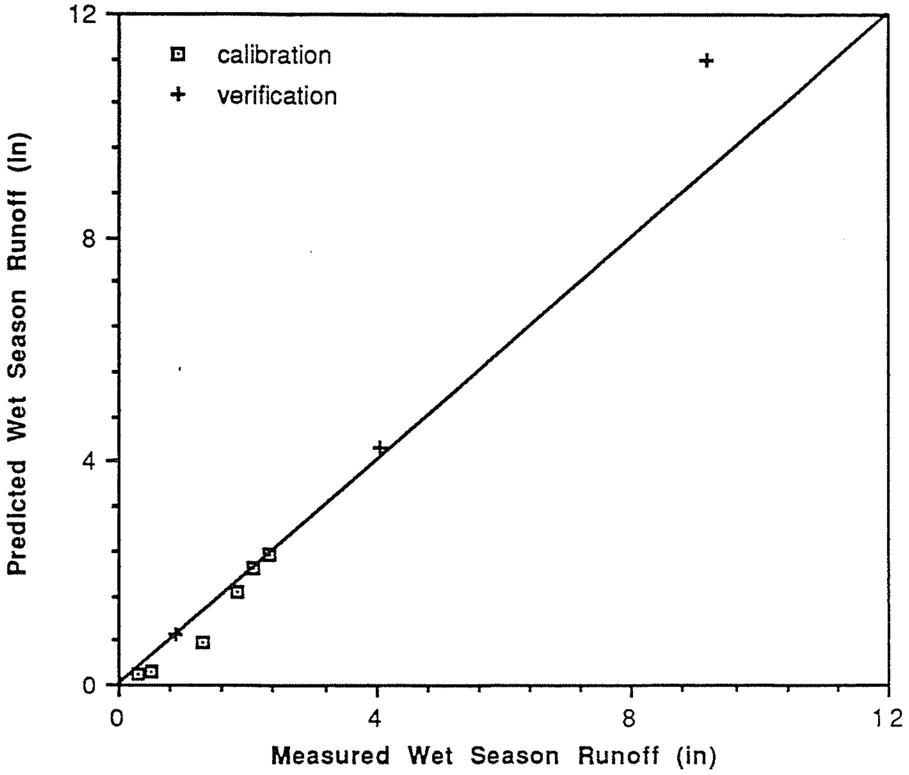


Figure B-10. Predicted versus Measured Wet Season Runoff for Berryessa Creek

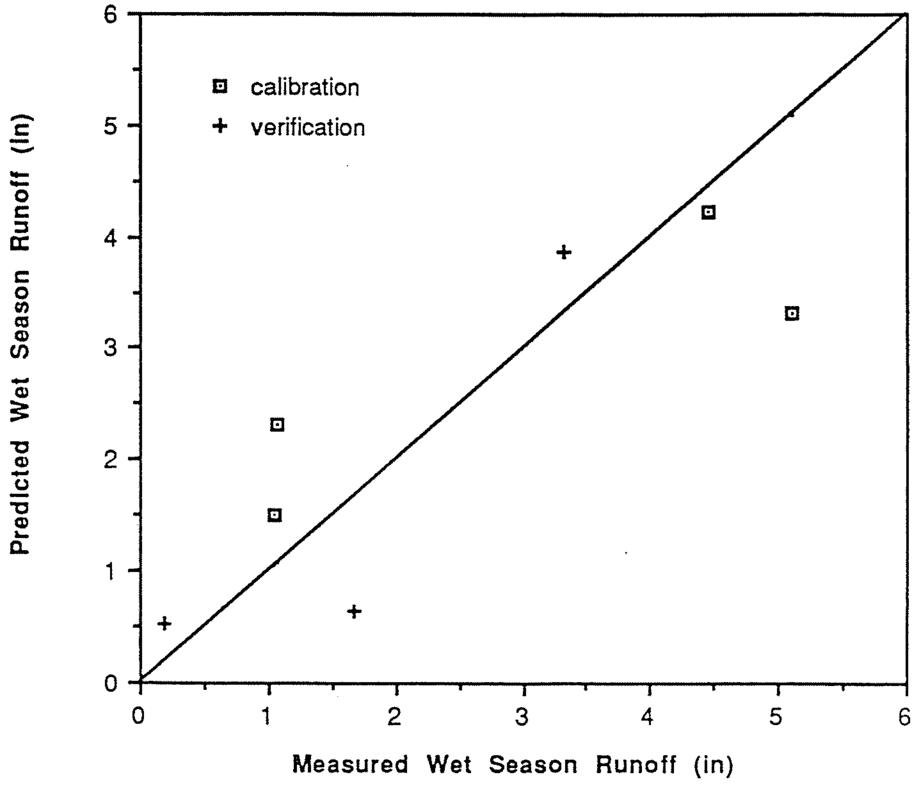


Figure B-11. Predicted versus Measured Wet Season Runoff for the Guadalupe River inches, so that the soil did not saturate until after the first or second major storm of the season.

B.3.4.2 Stevens Creek. Stevens Creek is in the western part of the valley, and extends from the county boundary in the Santa Cruz Mountains down to the Bay. Most of the undeveloped portion of the watershed flows into Stevens Creek Reservoir. This reservoir, while designed to store flows in the winter for release in the summer, does commonly release stormwater during wet years. Mean annual rainfall ranges from 12 inches near the Bay to 24 inches just below the reservoir, and is as high as 60 inches above Stevens Creek Reservoir.

Calibration of SWMM was performed only for the portion of the watershed below Stevens Creek Reservoir; flows out of the reservoir were represented by the record for SCVWD gage 44. Rain gage subareas were designated for SCVWD rain gages 100,48, and 121. The model was calibrated against measured flows at SCVWD gage 35, just north of the Central Expressway. To determine the amount of runoff occurring below the reservoir, flows from gage 44 (immediately below the reservoir) were subtracted from flows at gage 35. Also subtracted from the gage 35 record were diversion flows from Permanente Creek into Stevens Creek (measured by the difference between SCVWD gages 32a and 37). Calibration was limited to the period 1975 to 1983, when the diversion gage 37 was discontinued.

Figure B-6 shows the calibration results for Stevens Creek (areas downstream of Stevens Creek Reservoir). The RMSE for the combined calibration/verification period was 34 percent of the mean annual flow, and the BIAS was 1 percent. The model generally performed well, except in the 1981-82 season, when the model overpredicted runoff by about 60 percent. The predicted daily flow distribution passed the Kolmogorov-Smirnov distribution test at the 95 percent confidence level. Because the area downstream of the reservoir is mostly urbanized, the percent impervious area was the most important calibration parameter, although the Green-Ampt infiltration parameters were also important in modeling seasonal effects on runoff.

B.3.4.3 Sunnyvale East Channel. This watershed is a small urban area extending from the City of Cupertino down to the Bay. Mean annual rainfall in the basin ranges from 12 to 16 inches. The entire area was modeled using SCVWD rain gage 48. Calibration and verification were performed for the 1977 to 1989 record at SCVWD streamgage 74.

Calibration results are shown in Figure B-7. The RMSE in this case was 9 percent of the mean wet-season volume, while the BIAS was -1 percent. The predicted daily flow distribution passed the Kolmogorov distribution test at the 95 percent confidence level. The most important calibration parameters in this mostly urban, low rainfall catchment was the percent of impervious area; little or no seasonality was observed in runoff response to rainfall.

B.3.4.4 Saratoga Creek. Saratoga Creek extends from the county boundary in the Santa Cruz Mountains to its confluence with San Tomas Aquinas Creek. Mean annual rainfall ranges from 50 inches in the uplands to 12 inches near the Bay. For SWMM modeling, SCVWD rain gage 77 was used to represent the undeveloped upland areas, while rain gage 108 was used in the urban valley floor areas. Calibration and verification were performed on the record for SCVWD gage 25. The 1984-85 season was not included in the calibration or verification periods because the measured flow data for this year indicated an annual runoff coefficient of 0.95, which is unreasonable for a watershed which includes significant open and low-density residential areas.

Calibration and verification results for Saratoga Creek are shown in Figure B-8. The RMSE for the combined calibration/verification period was 22 percent of the mean wet-season volume, while the BIAS was .1 percent. The calibration of this watershed was complicated due to 1) the strong interflow recession component observed in many storms, and 2) the extremely strong response to runoff in wet years. To match observed storm response, it was necessary at times to force the model to shut off infiltration through saturation of the soil profile from below. Thus, the important model parameters were 1) the interflow recession constants, and 2) the soil and groundwater storage parameters.

B.3.4.5 San Tomas Aquinas Creek. This watershed is adjacent to Saratoga Creek and extends from the Santa Cruz Mountain foothills to its discharge point into Guadalupe Slough. Rainfall ranges from 12 to 40 inches per year on average. SCVWD rain gage 79 was used to represent the foothills and upper valley, gage 108 was used on the central valley floor, and the San Jose National Weather Service gage was used in the lower valley floor. Calibration was performed primarily at SCVWD streamgage 24, although data at SCVWD streamgage 29 were used to refine estimates of parameters in the upper portion of the catchment.

Calibration and verification results are shown in Figure B-9. The RMSE for wet-season volumes was 21 percent, while the BIAS was -2 percent. San Tomas Aquinas Creek was very similar to Saratoga Creek in terms of runoff, with storm hydrographs exhibiting a very strong interflow recession component and unusually strong response to rainfall. Again, the most important parameters were (1) interflow recession constants, and (2) soil and groundwater storage coefficients. An additional problem encountered here was the very different behavior of runoff between post-1983 and pre-1983 data. Measured flow data at gage 24 generally indicated less response to rainfall (i.e., lower runoff coefficients) after 1983, and we were unable to arrive at a calibration which could match both periods. One possible explanation for this is a change in the rating curve at gage 24 after the floods of the 1982-83 season.

B 3.4.6 Coyote Creek. This is the largest watershed in the valley, and drains the entire eastern side of the valley. Included are large undeveloped areas above Anderson Reservoir, Silver-Thompson Creek, Upper Penitencia Creek, and Berryessa Creek. For SWMM, Coyote Creek was modeled only between SCVWD streamgage 58 (below Anderson Reservoir) and the Bay; most of the area upstream of gage 58 either drain into reservoirs or are undeveloped areas. Storm runoff from these areas was therefore represented by the actual record for streamgage 58. The drainage area below this point is mixed urban and non-urban, with most of the non-urban areas located in the upper portions of Silver-Thompson and Upper Penitencia Creek.

The only streamgage on Coyote Creek below gage 58 is a high-flow gage which records only when stage is above 8.5 feet; the record here is consequently of limited usefulness. However, a continuous stage recorder was installed at this location for the 1988-89 sampling period as part of this study. Thus, Coyote Creek was calibrated for one year only (1988-89). This period was relatively dry, and use of the model for wetter years should be less reliable than if it had been calibrated over a variety of hydrologic conditions. The predicted wet-season volume for this period was 1 percent lower than measured. Because of the dryness of the calibration period, the most important calibration parameter was the percent of impervious area.

B.3.4.7 Berryessa Creek. The Berryessa Creek watershed is located on the eastern side of the valley on the slopes of the Diablo Range, and flows into Coyote Creek near the Bay. Rainfall in this area is much lower than in the Santa Cruz Mountains, and ranges from 14 to 20 inches on average per year. SCVWD rain gage 23 was used to model the upper parts of the catchment, and the San Jose National Weather Service gage was used to model the lower portions of the catchment. Calibration and verification were performed at SCVWD streamgage 64.

Figure B-10 show the calibration and verification results for this watershed. The overall RMSE was 29 percent of the mean annual flow, and the BIAS was 6 percent. The calibration was adequate in most years, with most of the RMSE resulting from the 2-inch overprediction of runoff in 1982-83.

B.3.4.8 Guadalupe River. The Guadalupe River is the second largest watershed in the valley, and extends from the Santa Cruz Mountains to the Bay. Major tributaries include Los Gatos Creek, Ross Creek, Calero Creek, Alamitos Creek, and Canoas Creek. Mean annual rainfall in the basin ranges from 12 inches near the Bay to about 50 inches on the Santa Cruz Mountain ridgeline. Rain gages used to model the watershed are shown in Table B-1.

The SCVWD operates an extensive reservoir and recharge system on the Guadalupe River. Most of the areas in the Santa Cruz Mountains drain into Lexington, Guadalupe, Almaden, and Calero reservoirs. Water released from Lexington Reservoir is also stored in Vasona Reservoir. For the most part, these reservoirs are designed to store runoff in the winter and release in the summer for groundwater recharge. However, during wet years the reservoirs do release significant volumes of winter storm runoff. Outflows from each reservoir are measured by stream gages located immediately below the reservoir spillways. Much of the water released by reservoirs during dry weather is diverted downstream into groundwater recharge ponds. Water can also be diverted into the watershed from Coyote Creek through the Coyote-Alamitos Canal.

Calibration and verification of SWMM on the Guadalupe River was performed using the flow record for the U.S. Geological Survey (USGS) gage immediately below the confluence with Los Gatos Creek. This gage is downstream of the recharge ponds, and represents all of the major Guadalupe tributaries. It does not measure runoff from much of the urban San Jose portion of the watershed. Calibration was performed for runoff from areas downstream of reservoirs; runoff above the reservoirs was represented in loads calculations by the actual reservoir release records. To determine the volume of runoff occurring downstream of reservoirs, reservoir releases were subtracted from the USGS gage record using the following rules:

1) During storms, all of the water released from reservoirs reaches the USGS gage.

2) Between storms, all of the flow recorded by the USGS gage consists of reservoir releases minus diversions to recharge ponds.

These rules basically assume that released water is not diverted during storms, and that dry-weather reservoir releases are much larger than natural baseflow.

Calibration efforts on the Guadalupe River were less successful than at other watersheds, primarily because the Guadalupe River watershed is a highly managed system with numerous storage reservoirs and diversions. Because there were insufficient data to account for all of the stored and diverted water in the watershed, it was difficult to differentiate between storm runoff and water released from other sources. In several years, these data indicated storm runoff coefficients (runoff/rainfall) greater than 1.0 in February and March. As a results, SWMM was calibrated only during periods in which the measured flow data appeared to be reasonable (i.e., had reasonable runoff coefficients). Even focusing on these periods, the calibration/verification resulted in a wet-season RMSE of 40 percent and a BIAS of -2 percent. Calibration and verification results are plotted on Figure B-11. The predicted daily flow distribution passed the Kolmogorov-Smirnov test at the 95 percent confidence level. This calibration could have been improved by using parameter values which were completely inconsistent with those used in other basins. For instance, to match observed dry year totals (when all runoff is from impervious areas), the model would require percent impervious areas ranging from 1 to 20 percent in urban areas. In other similar basins, this parameter generally ranged from 10 to 80 percent. Given the mass balance problems observed in the measured flow data, the final calibration was determined using the best combination of parameters that was consistent with values used on Calabazas, Saratoga, San Tomas Aquinas, and Stevens Creek.

B.3.4.9 Comparisons of Predictions with Observed Flows for Selected Storms. An important component of any calibration is visual comparison of predicted hydrographs with measured hydrographs. Analysis of calibration statistics alone is not sufficient; visual comparison must also be made to ensure that the model predictions are consistent with our understanding of the relevant physical processes. In this section, selected predicted and measured hydrographs are presented to give the reader some idea of how well we were able to simulate storm hydrographs.

Figures B-12, B-13, and B-14 are examples of the range of hydrograph comparisons we were able to obtain. Figure B-12 shows the measured and predicted daily average flows for February 1980 storms in Calabazas Creek, and is an example of an excellent match between the model and the observed flows. Both the peak and storm recession are accurately predicted by the model. Figure B-13 illustrates a poor match between predicted and observed flows for a December 1977 storm on San Tomas Aquinas Creek. In this case, the model significantly overpredicted the peak flow rate and total storm volume. Figure B-14 shows a perhaps more typical hydrograph comparison for a March 1979 storm on San Tomas Aquinas Creek. Here, the model overpredicts the peak flow rate by about 20 percent, but is able to accurately simulate the total storm volume.

B.4 WATERSHED RUNOFF PREDICTIONS

The goal of the SWMM calibration discussed in the previous section was to produce a model which could 1) estimate runoff in ungaged areas, and 2) estimate the contributions of various land uses to runoff. This section summarizes storm runoff predictions for the Santa Clara Valley. These predictions were made for all watersheds for water years 1977-78 through 1988-89, the period for which rainfall data are available for all catchments.

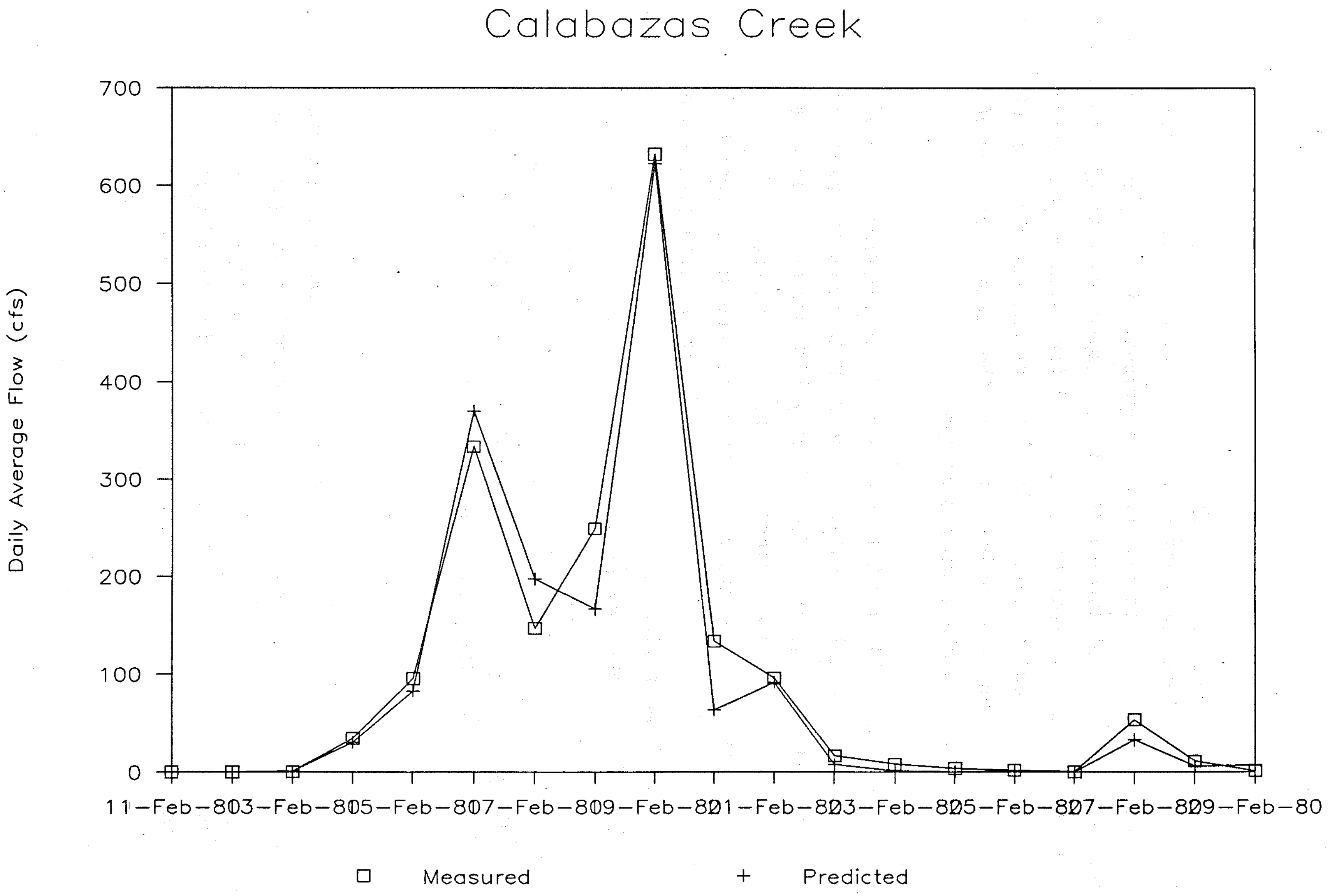


Figure B-12. Comparison of Predicted and Measured Hydrographs for Calabazas Creek, February 1980

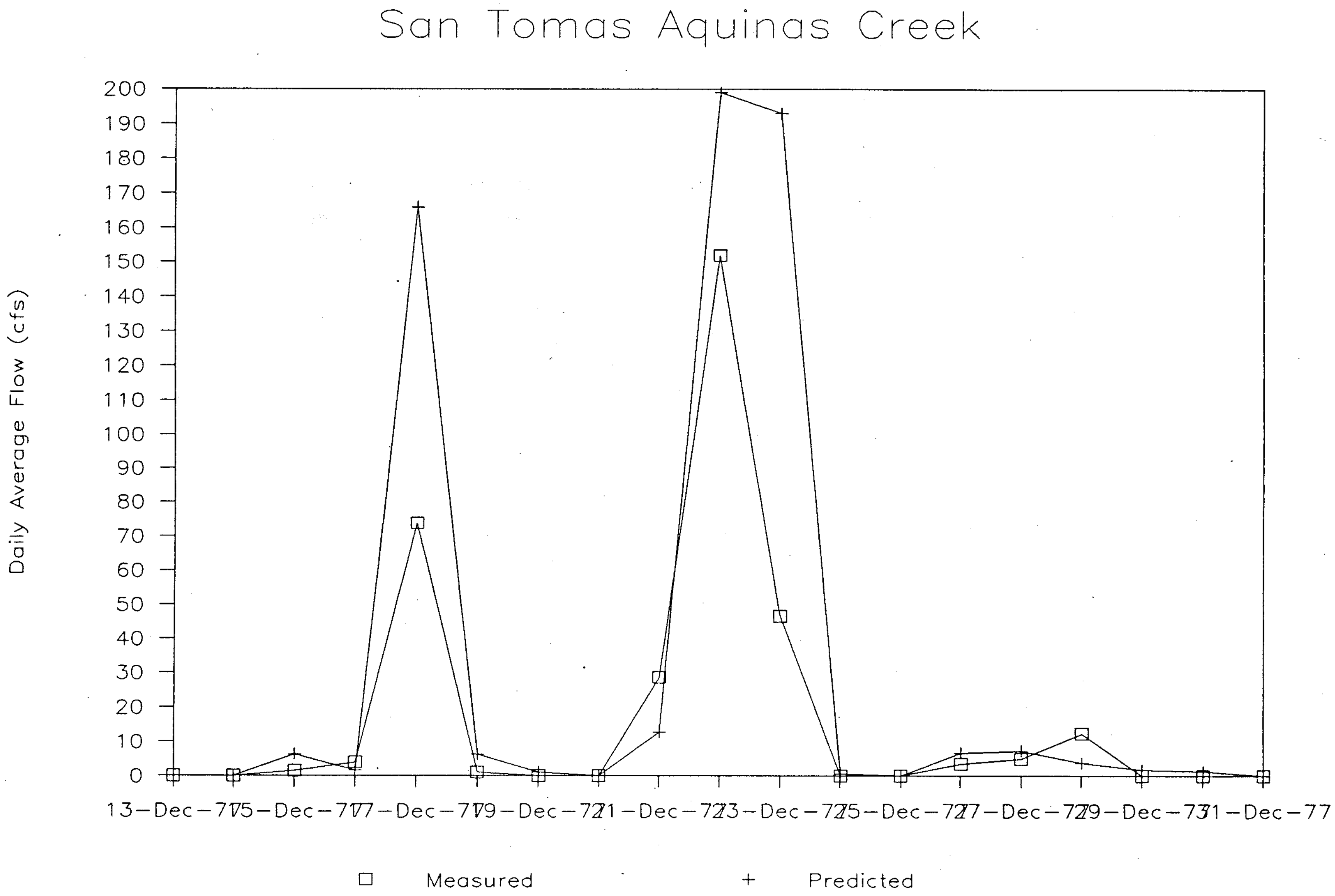


Figure B-13. Comparison of Predicted and Measured Hydrographs for San Tomas Aquinas Creek, December 1977

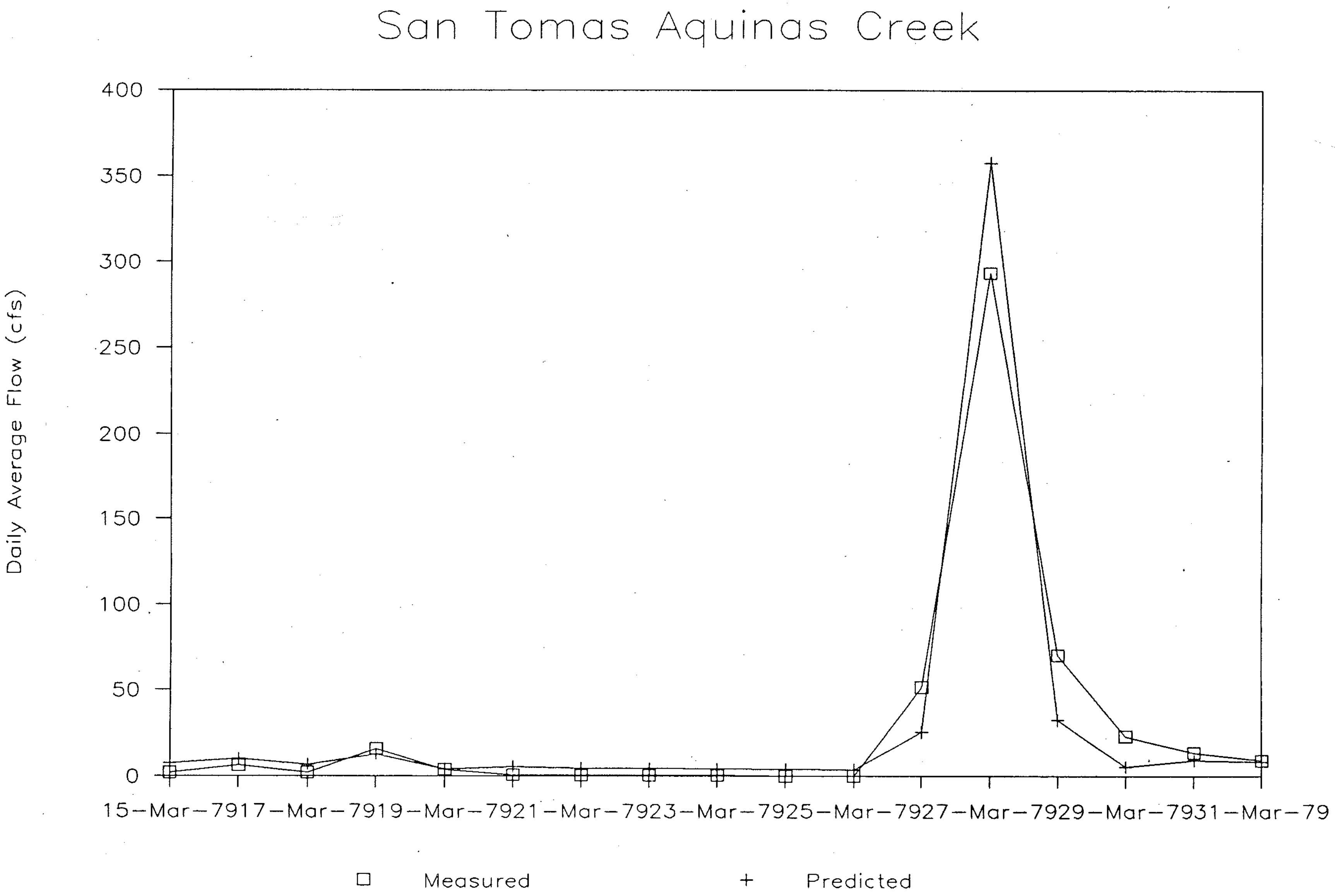


Figure B-14. Comparison of Predicted and Measured Hydrographs for San Tomas Aquinas Creek, March 1979

SWMM was used to predict runoff in three types of areas:

1) Areas for which the model was calibrated against measured streamflow data

2) Areas in calibrated watersheds that are downstream of the calibration gage

3) Watersheds for which no flow data are available for calibration

For areas in which the model was calibrated, flow predictions were made by simply running the calibrated version of the model for the projection period. To account for model errors in calibration/verification years, the predicted flows for each land use were then multiplied by the ratio of wet-season measured runoff to predicted runoff for that year. This correction scaled the predicted flows to match measured totals exactly, and assumed that the correction factor was the same for all land uses.

For watersheds with streamflow data for calibration, there were usually uncalibrated urban areas in the lower portions of the watersheds. This applies to the following watersheds: Coyote Creek, Guadalupe River, Calabazas Creek, Saratoga Creek, San Tomas Aquinas Creek, Sunnyvale East Channel, and Stevens Creek. Because Sunnyvale East Channel best represents typical northern valley urban areas, parameters calibrated for this watershed were used in other uncalibrated urban areas. Soils parameters were estimated based on soil type and calibration in areas with similar soils.

Most of the western portion of the valley has little or no flow data for calibration. This includes Permanente Creek, Adobe, Matadero, and Barron creeks, and Sunnyvale West Channel. In addition, as only the portion of the San Francisquito Creek watershed in Santa Clara County was modeled, flow data could not be used for calibration. In these areas, parameters were estimated from similar calibrated watersheds. In urban areas on the lower valley floor, parameters were estimated based on the calibration for Sunnyvale East Channel. In areas on the upper valley floor, parameters were estimated from the calibrations for Stevens Creek and Calabazas Creek. Finally, in upland areas calibration results for Stevens, Calabazas, and San Tomas Aquinas creeks were used to estimate parameters.

Table B-9 summarizes the predicted annual storm runoff volumes for each watershed in the valley. As would be expected based on the relative drainage areas, 50 percent of storm runoff on average comes from Coyote Creek and the Guadalupe River. The highest runoff volume occurred during the 1982-83 season, while the lowest occurred in the 1988-89 season.

B.5 DETERMINISTIC WATER QUALITY MODELING OF CALABAZAS CREEK

As described in Section 8, loads in this study were derived as the product of annual runoff volume (from SWMM modeling) and annual mean concentration for each constituent and land use. These mean concentrations were obtained from statistical analysis of the water quality data collected at the land use and stream sampling stations. An alternative approach to estimate loads is to use the semi-empirical buildup-washoff models included in SWMM to predict runoff water quality. While these models are highly empirical and largely unverified, they do attempt to represent a number of the physical processes that are thought to determine runoff water quality. To compare this approach to the statistical mean concentration approach used in this study, the SWMM buildup washoff model was applied to estimate annual load from the Calabazas Creek watershed. A description of the model, calibration results, and predicted loads are provided in this section, as well as a comparison of the buildup-washoff load predictions to those derived from the statistical mean concentration model.

B.5.1 Model Description

The SWMM runoff water quality model is based on the concept of pollutant buildup and washoff. The concept behind this model is that a

Table B-9. Storm Runoff Predictions for the Study Area

TOTAL WET WEATHER FLOWS (ac-ft)

Year	Coyote	Guadalupe	San Tomas	Saratoga	Calabazas	Sunnyvale East	Sunnyvale West	Stevens	Permanante	ABM	San Francisquito	Total
77-78	15255	47158	14145	5110	9652	2192	1746	1632	5986	9357	1834	114066
78-79	11374	7491	5058	1630	3800	1160	1011	1204	1443	4082	755	39008
79-80	22384	26979	12414	6922	8136	2191	1510	1979	6685	9352	1973	100523
80-81	6089	6946	3646	1408	2297	925	694	676	982	2967	330	26960
81-82	16827	46421	14022	10786	9539	2526	2038	1645	9066	11845	2634	127348
82-83	42636	97976	20866	21380	15557	3698	2874	4787	17934	17617	3801	249125
83-84	8054	6372	4893	3483	4282	1190	1003	896	832	4441	992	36439
84-85	6609	8927	2539	814	2044	1383	1011	845	1176	3407	655	29411
85-86	18857	78009	12902	13197	8308	2792	1980	2167	8972	11678	1599	160462
86-87	5400	5709	1584	704	1856	689	577	445	452	3303	1521	22238
87-88	6799	8625	2141	977	2138	828	783	652	722	2317	366	26348
88-89	3507	1287	1877	506	1154	553	613	456	347	1293	200	11792
Average	13649	28492	8007	5577	5730	1677	1320	1449	4550	6805	1388	78643

TOTAL WET WEATHER FLOWS (%)

Year	Coyote	Guadalupe	San Tomas	Saratoga	Calabazas	Sunnyvale East	Sunnyvale West	Stevens	Permanante	ABM	San Francisquito	Total
77-78	13.4	41.3	12.4	4.5	8.5	1.9	1.5	1.4	5.2	8.2	1.6	100
78-79	29.2	19.2	13.0	4.2	9.7	3.0	2.6	3.1	3.7	10.5	1.9	100
79-80	22.3	26.8	12.3	6.9	8.1	2.2	1.5	2.0	6.6	9.3	2.0	100
80-81	22.6	25.8	13.5	5.2	8.5	3.4	2.6	2.5	3.6	11.0	1.2	100
81-82	13.2	36.5	11.0	8.5	7.5	2.0	1.6	1.3	7.1	9.3	2.1	100
82-83	17.1	39.3	8.4	8.6	6.2	1.5	1.2	1.9	7.2	7.1	1.5	100
83-84	22.1	17.5	13.4	9.6	11.8	3.3	2.8	2.5	2.3	12.2	2.7	100
84-85	22.5	30.4	8.6	2.8	6.9	4.7	3.4	2.9	4.0	11.6	2.2	100
85-86	11.8	48.6	8.0	8.2	5.2	1.7	1.2	1.4	5.6	7.3	1.0	100
86-87	24.3	25.7	7.1	3.2	8.3	3.1	2.6	2.0	2.0	14.9	6.8	100
87-88	25.8	32.7	8.1	3.7	8.1	3.1	3.0	2.5	2.7	8.8	1.4	100
88-89	29.7	10.9	15.9	4.3	9.8	4.7	5.2	3.9	2.9	11.0	1.7	100
Average (%)	21.2	29.6	11.0	5.8	8.2	2.9	2.4	2.3	4.4	10.1	2.2	100

supply of constituents builds up on the land surface during dry periods and is subsequently washed off during a storm. Pollutant buildup is assumed to occur as a function of time between storms. During a storm, washoff is assumed to occur as a function of the available mass of pollutants on the land surface and the rate of runoff. While the buildup-washoff concept does explain some of the mechanisms thought to produce runoff water quality, the model itself is highly empirical and requires substantial calibration to produce reasonable results.

Many studies have been conducted to determine rates of buildup on city streets. Sartor and Boyd (1972), among others, found that buildup appears to be non-linear, developing rapidly at first and then leveling off to a limit. This form of buildup is implemented in SWMM using an exponential buildup function:

$$P_{Shed} = P_{lim}*(1-\exp(-K_b*t)) \qquad \text{(B-7)}$$

where

P_{Shed} = mass of constituent in watershed at time t (lbs/acre)
P_{lim} = upper limit on constituent mass that can accumulate (lbs/acre)
K_b = buildup rate constant (days^{-1})
t = time between storms (days)

Washoff is the process that mobilizes the accumulated constituents into runoff and streamflow. In stream channels and other areas of significant flow, this process is described by sediment transport theory, where flow rate and bottom shear stress are important factors. For thin overland flows (sheet flows) common during storms in urban environments, rainfall energy can also mobilize particles. Therefore, more intense storms are able to washoff more of a constituent than a less intense storm. Whatever mechanisms are involved, it is obvious that as rainfall and washoff continue the amount of constituent remaining in the watershed diminishes.

This observation, combined with the results of several empirical studies leads to the washoff formula used in SWMM:

$$\mathrm{Poff}(t) = K_w * r^c * P_{shed} \qquad \text{(B-8)}$$

where

Poff = amount washed off at time t (lbs/acre)
K_w = washoff coefficient
r = runoff rate (in/hr)
c = empirical washoff exponent

Thus, the model has four input parameters: the limiting buildup rate (P_{lim}), the buildup rate constant (K_b), the washoff coefficient (K_w), and the washoff exponent (c). The buildup limit sets an upper limit on the availability of the constituents, and has a linear effect on the total mass load. The buildup rate constant sets the time scale of buildup between storms and thus attempts to capture the effects of "antecedent conditions." It can therefore be used to match observed water quality variations between sequential storm events. The washoff coefficient has a linear effect on the total mass that washes off during a storm. The washoff exponent primarily controls how load varies with time during a storm.

B.5.2 Model Calibration

None of the buildup-washoff model parameters can be measured directly, and all must be estimated by calibrating the model against measured water quality data. Few data on initial estimates of the buildup parameters are available in the literature for the types of constituents of concern in this study, although there are data on buildup rates of "dust and dirt" on parking lots and streets. The SWMM manual suggests an initial estimate of the washoff coefficient K_w of 4.6 in_{-1}, although other studies have used values ranging from .052 to 6.6 in_{-1}. The washoff exponent is suggested to range from 1.0 to 2.0, with a median value of 1.5.

B.5.2.1 Data Used for Calibration. The buildup washoff model was calibrated against water quality data collected at the Calabazas Creek monitoring station (S1) for five storms in the 1988-89 season. The available water quality data consisted of Event Mean Concentrations (EMCs) derived from composite samples; no data on the time-dependence of concentrations within a storm were available. Three constituents, Total Suspended Solids (TSS), copper and lead, were chosen for this test of the water quality model portion of SWMM. Measured EMCs used in calibration are listed in Table B-10.

B.5.2.2 Calibration Methods. The goal of calibration was to match to the extent possible the observed EMCs for the five storms for each constituent. Calibration was performed by systematically changing the values of the four buildup washoff parameters to minimize the difference between the simulated and observed EMCs. A number of parameters were used to measure the accuracy of the calibration. The root mean square error (RMSE) of predicted vs. observed EMCs was used to quantify the magnitude of model calibration errors. This was reported as a percentage of the mean measured concentration. The BIAS, or sum of errors, was used to indicate if the model was systematically under or overpredicting EMCs. To verify that the model was reproducing the statistics of the measured data, the predicted mean and coefficient of variation of the EMCs for the five storms were compared to the mean and coefficient of variation of the observed data. Finally, the data for each storm were tabulated and plotted as a function of time to verify whether or not the model was reproducing the observed trends in the data.

B.5.2.3 Calibration Results. Table B-10 compares the calibrated model to the measured data, and lists the calibration statistics for each constituent. Final calibrated values of the model input parameters are shown in Table B-11. RMSEs for the calibrations ranged from 19 percent for copper to 25 percent for TSS, and were relatively unbiased. The model was able to accurately reproduce the means of the observed data, but consistently underestimated the coefficient of variation of the data.

Table B-10. MEASURED AND CALIBRATED EMCs

	TSS mg/l		Copper ug/l		Lead ug/l	
STORM	Measured	Calib.	Measured	Calib.	Measured	Calib.
11/23/89	360	230	95	67	99	92
2/3/90	34	170	30	50	60	68
2/8/90	63	186	31	55	36	74
3/2/90	180	192	44	56	5	77
3/23/90	205	116	58	34	80	47
Mean	195	180	53	53	80	72
CV	1.22	0.26	0.51	0.26	1.80	0.26
% RMSE		25		19		22
% BIAS		18		9		28

CV = Coefficient of Variation

Table B-11. CALIBRATED VALUES OF WATER QUALITY MODEL INPUT PARAMETERS

Constituent	Plim	Kb	Kw	a
TSS	82000	0.04	2.3	1.3
Copper	24	0.04	2.3	1.3
Lead	33	0.04	2.3	1.3

Figure B-15 compares the predicted and observed EMCs as a function of time for Copper. The model was able to reproduce the relatively high concentrations observed in the first November storm, but was unable to simulate the low concentrations found in the January and February storms. Much of the rainfall in 1988-89 occurred in the last week of December 1988, and the low concentrations observed in January may be a result of heavy washoff of constituents from street surfaces in December. However, the model did not reproduce this effect. The model also could not reproduce the rapid drop in concentration that was measured in the second of the two March storms. Overall, although the model was on average able to match observed concentrations with an RMSE of about 20 percent, it was not particularly successful at matching the observed sequence and timing of storm concentrations.

B.5.3 Comparison of Annual Load Estimates for Deterministic and Constant Concentration Water Quality Models

The calibrated water quality model was used to estimate annual loads for the 12 year simulation period (water years 1977-78 to 1988-89). Table B-12 compares these results to the annual load predictions obtained from the statistical mean concentration model. In dry years such as the 1988-89 calibration period the two models give comparable estimates of annual load. However, the deterministic water quality model predicts loads that are 2-3 times lower in wet years such as 1982-83. Overall, the deterministic water quality model predicts significantly lower concentrations than does the mean concentration model.

The reasons behind this difference between the two methods lie primarily in the assumptions behind the buildup-washoff model. During wet years, the buildup-washoff model assumes that the increased number of storms will reduce the mass of pollutant available on the street surfaces for washoff. Thus, although flow volumes may be an order of magnitude higher in wet years than in dry years, predicted concentrations in runoff are lower due to this source limitation effect. On the other hand, the

Figure B-15. Observed vs. Predicted Concentrations for Copper

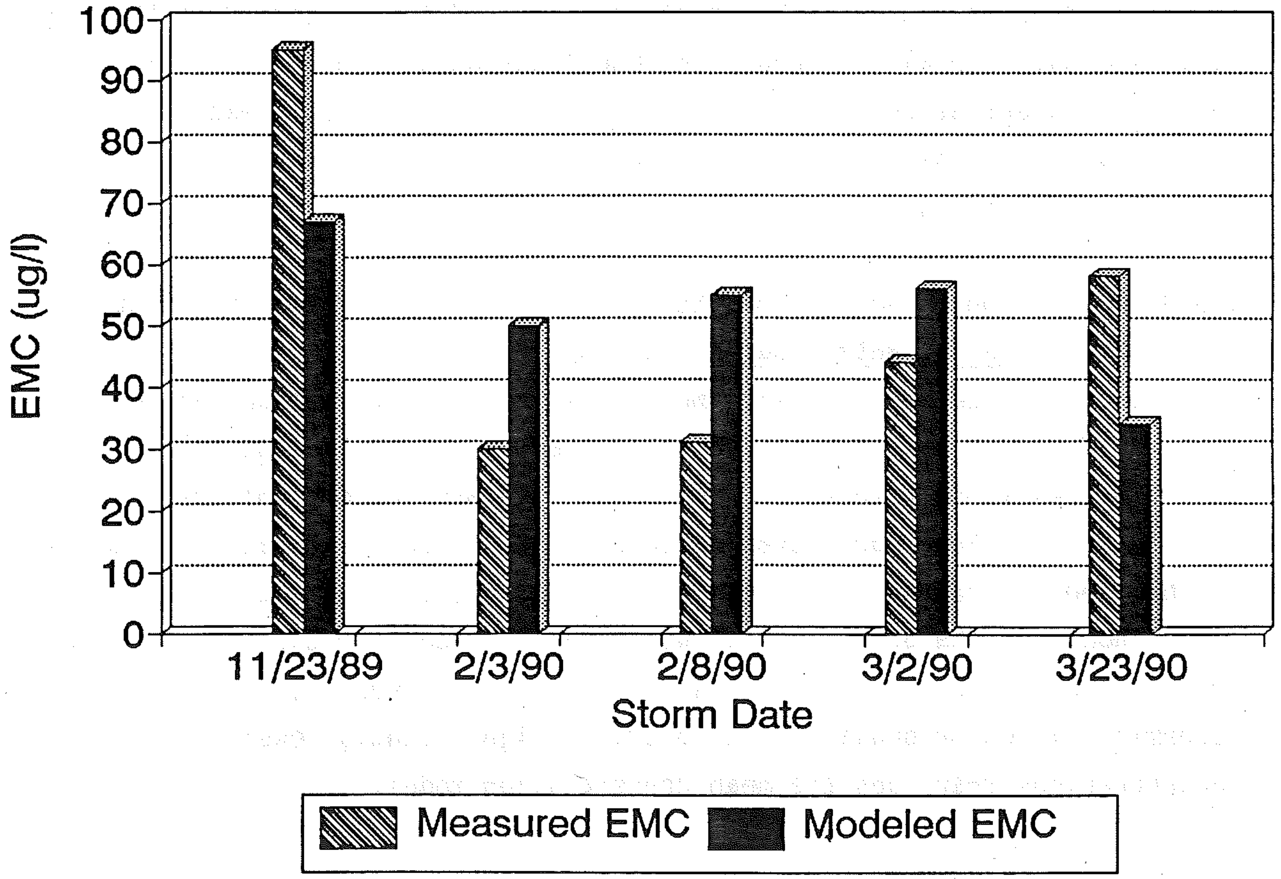


Table B-12. COMPARISON OF ESTIMATED LOADS FOR CALABAZAS CREEK

LOAD IN POUNDS

	TSS		COPPER		LEAD	
WATER YEAR	Buildup-Washoff	Mean Conc.	Buildup-Washoff	Mean Conc.	Buildup-Washoff	Mean Conc.
1978	2,000,000	7,400,000	559	1,798	798	1,791
1979	1,210,000	2,900,000	338	700	483	696
1980	1,980,000	6,200,000	555	1,485	793	1,475
1981	1,180,000	1,800,000	330	422	472	420
1982	2,860,000	7,300,000	800	1,760	1,140	1,751
1983	2,980,000	11,900,000	834	2,850	1,190	2,831
1984	1,460,000	3,300,000	407	797	582	794
1985	1,260,000	1,600,000	352	405	503	407
1986	1,980,000	6,300,000	554	1,601	791	1,604
1987	724,000	1,400,000	203	375	289	378
1988	1,060,000	1,600,000	296	426	423	428
1989	580,000	870,000	162	238	232	240
Mean	1,630,000	4,380,833	457	1,071	652	1,068
Mean w/o 1982-83	1,481,273	3,697,273	414	910	591	908

mean concentration method assumes no difference in average water quality between wet and dry years. There is of course no direct evidence that the "dilution" effect predicted by the buildup-washoff model actually occurs. In this study, little or no correlation was found between the time between storms and runoff concentration, implying that the number of storms in a year should have little effect on water quality concentrations.

In summary, the deterministic water quality model predicts significantly lower loads and concentrations in wet years. The model does account for a number of mechanisms that one would intuitively believe to occur during and between storms. However, the model requires substantial calibration, and was not able to accurately simulate observed patterns in water quality during the 1988-89 monitoring period. The mean concentration model used in loads estimation in the remainder of this study makes direct use of the observed water quality data, and requires little calibration. The mean concentration model, however, is unable to account for possible differences in water quality during wet and dry years. Currently, there are no data available to determine which (if either) of these models is best able to simulate water quality in wet years.

APPENDIX C

SUMMARY OF LABORATORY QA/QC

APPENDIX C
SUMMARY OF LABORATORY QA/QC

Evaluation of the quality of the analytical data included:

1) Precision of laboratory duplicates (Table C.1)
2) Precision of field duplicates (Table C.2)
3) Precision of matrix spike and matrix spike duplicate recoveries (Table C.3)
4) Potential contamination of field and laboratory (method or reagent) blanks (Table C.4)
5) Laboratories performance on Environmental Resources Associates (ERA) quality control samples (Table C.5)

C.1 WATER SAMPLES

C.1.1 Laboratory Duplicates

Laboratory duplicates were routinely performed by the laboratory for a reduced suite of parameters. The only exception was for dry-weather 3 (May 12, 1989) and wet-weather 1 sampling events (May 5, 1989), where laboratory duplicate analyses were not generated. Results of laboratory duplicate analyses are presented in Tables C.1-1 to C.1-12. The precision of the laboratory duplicates is an indication of the variability in the extraction and analytical procedures in the laboratory. This precision is commonly expressed as a relative percent difference (RPD). The RPD was calculated by the following equation:

$$|\text{Conc (A)} - \text{Conc (B)}|/\{[\text{Conc (A)} + \text{Conc (B)}]/2\}$$

where

Conc (A) = Concentration of primary duplicate sample
Conc (B) = Concentration of secondary duplicate sample
|Conc (A) - Conc (B)| = Difference between concentrations of primary and secondary duplicates expressed as absolute values

For the dry-weather sampling events 1, 2, 4, 5, 6, and 7, the RPD ranged from 0 to 29%, with a mean value of 6%. The RPDs for all wet-weather sampling events (2 to 7) were between 0 to 40% (mean of 16%), with the exception of two elevated RPDs for lead (55%) and mercury (100%) analyses for wet-weather 2 duplicate samples. Thus the reported RPDs for both dry and wet-weather samples are considered to be within laboratory acceptable limits.

C.1.2 Field Duplicates

Results of field duplicate samples are an indication of overall field variability, precision of field sampling and laboratory analyses. As such, the results of field duplicates have more variability than laboratory duplicates, which measure only laboratory performance. Field duplicate samples were collected and analyzed for a reduced parameter suite for all dry and wet-weather sampling events, with the exception of wet-weather 1 (May 5, 1989). The results of field duplicate analyses are presented in Tables C.2-1 to C.2-13. For all dry-weather field duplicate samples, the RPD ranged from 0 to 100%, with a mean of 23%. The RPD ranged from 0 to 94% for all wet-weather field duplicate samples; the mean value was 31%. These mean field duplicate RPDs are higher than the laboratory duplicate RPDs by about a factor of two to three, and likely represent the additional variability from field sampling.

C.1.3 Matrix Spike and Matrix Spike Duplicates

Matrix spike (MS) and matrix spike duplicate (MSD) recovery data are performed to evaluate accuracy and precision of each individual analytical method. The results of MS and MSD recoveries and also the RPD of these matrix spikes are summarized in Tables C.3-1 to C.3-10. Matrix spike recoveries for specific compounds analyzed under each method evaluated in this program were within acceptable limits according to the current EPA guidance for laboratory analyses (EPA, Test Methods for Evaluating Solid Waste, SW846, Third Edition). The RPD between MS and MSD recoveries were generally less than 30%, and therefore considered to be within EPA acceptable limits.

C.1.4 Laboratory (Method or Reagent) and Field Blanks

The purpose of laboratory and field blank analysis is to detect potential contamination from the laboratory and/or field sampling. All laboratory method blanks and field blanks were generally free of contaminants, with the exception of the detections of some organic compounds and metals.

C.1.4.1 Metals. It is important to note that the collection of field blanks in this sampling program was different for the dry- and wet-weather sampling events. Field blanks were obtained using procedures identical to those for collection of field samples. Dry-weather samples were collected by dipping sample containers in the sampling stream. Correspondingly, field blanks were collected by pouring laboratory reagent water (Milli-Q purified) into sample containers at each sampling station. Wet-weather composite samples were collected in the ISCO samplers in 10-liter borosilicate bottles, which were then taken to the laboratory. In the laboratory, a peristaltic pump with Teflon hose was used to fill individual sample bottles required for the various analyses (e.g., metals, pesticides, etc.). The Teflon hose was flushed with laboratory reagent water every time a new 10-liter sample bottle from each of the sampling stations was to be drained. At the end of this process, the Teflon hose was flushed and then laboratory reagent water was used to fill sample bottles for the blank analysis. This method of blank collection is commonly known as an equipment blank. Hereinafter, all "field blanks" collected in the wet-weather period will be referred to as equipment blanks.

For the dry-weather samples, field blanks showed low levels of zinc contamination in dry-weather 4 (0.011 mg/L), dry-weather 5 (0.014 mg/L), dry-weather 6 (0.010 mg/L), and dry-weather 7 (0.006 mg/L). These levels of zinc were generally equal to or lower than the actual zinc levels found in the stream samples (Stations S1 to S4). No zinc contamination was found in the method blank analyses for the above-listed dry-weather sampling rounds. Because the method blanks were free of contamination, the source of the zinc contamination in the field blank is not the laboratory reagent water or the acid-preservative.

In addition, mercury and lead were detected at 0.0003 mg/L and 0.003 mg/L in dry-weather 4 and 6, respectively. The impact of mercury and lead contamination on the actual concentrations found in water samples is minimal because of the following reasons:

1) Mercury and lead were not detected in method blanks.

2) Mercury and lead concentrations in the field blank are close to the detection limit of 0.0001 mg/L and 0.001 mg/L, respectively.

3) Mercury levels detected in actual water samples are about 10 times higher than those found in the field blank.

4) Lead was not detected in actual water samples except for a lead concentration of 0.004 mg/L detected in one stream sample.

For the wet-weather samples, low levels of some metals were detected in the equipment blanks from wet-weather 2 (Table C.4-8), wet-weather 3 (Table C.4-10), wet-weather 5 (Table C.4-12), and wet-weather 7 (Table C.4-14). The source of contamination is potentially from carryover of residual metals found in the hose used with the peristaltic pump. The concentrations found in the actual water samples were not corrected for these metal contaminants because all method blanks were generally free of metal contamination for the above-listed wet-weather sampling events with the exception of wet-weather 2, in which cadmium was detected in the method blank at the detection limit of 0.0002 mg/L.

For wet-weather 6, five metals--chromium (0.052 mg/L), copper (0.011 mg/L), lead (0.001 mg/L), nickel (0.06 mg/L), and zinc (0.018 mg/L)--were detected in the equipment blank. The source of these elevated metals is probably from the laboratory water. Because the Milli-Q purification system was broken during this sampling event, laboratory water was obtained from the solar still, which probably contained the elevated metals. Although the equipment blank was contaminated, the metals results for the actual water samples should not be affected because the samples did not come in contact with the solar still water except perhaps for a very small volume that may have adhered to the tubing from the flushing operation. The method blank analysis generally did not detect any metals concentrations that were comparable to those found in the equipment blank. For wet-weather 6, the only metal detected above the detection limit in the method blank was chromium. Chromium was detected at 0.002 mg/L in the first method blank and at a lower level of 0.001 mg/L in the second method blank.

C.1.4.2 Organics. Two volatile organics, methylene chloride and acetone, were detected in method blanks. Methylene chloride was detected at 6, 11, and 7 μg/L in method blanks for dry-weather 1 and 2, and wet-weather 1, respectively. Acetone was detected twice at 27 and 20 μg/L for dry-weather 2 and wet-weather 1, respectively. These volatile organics are commonly used solvents in the laboratory for sample extractions. Therefore, the detections of methylene chloride and acetone in storm runoff samples during dry-weather 1 and 2, and wet-weather 2, are suspect and most probably due to laboratory contamination.

A semi-volatile organic, bis(2-ethylhexyl)phthalate (BEHP), was detected in method blanks from dry-weather 1 and 2, and wet-weather 1 and 2. The concentrations of BEHP ranged from 11 to 800 µg/L. The presence of BEHP is common in plastic material such as gloves and tubing. According to the current guidance from EPA on evaluation of phthalate data (EPA 1988), phthalates are common laboratory contaminants at levels of less than 100 µg/L. Based on evidence of BEHP contamination in the laboratory and EPA's current position on phthalate compounds, the detections of BEHP in storm runoff samples from L1, L2, and L6 are therefore suspect and most probably due to laboratory contamination.

A detection of 4,4'-DDE at 0.077 µg/L was found in a field blank from wet-weather 3. Since this organochlorine compound, 4,4'-DDE, was not detected in any of the storm runoff samples for wet-weather 3, this one-time detection of 4,4'-DDE in a field blank is likely due to field or laboratory contamination, and does not impact the results of organochlorine analyses of water samples collected from wet-weather 3.

C.2 SEDIMENT SAMPLES

Results of QC analyses for sediment samples are presented in Tables C.1-13, C.2-14 to C.2-16, and C.3-11 to C.3-14. Generally, the RPDs for laboratory and field duplicates were similar to those reported for the water samples. Matrix spike recoveries and RPDs of these matrix spike recoveries were also within acceptable limits.

As with the water samples, BEHP was detected in method blanks in the second and third sampling rounds. BEHP concentrations ranged from 940 to 2400 µg/kg. The ubiquitous presence of BEHP in both laboratory and field environments is discussed earlier in Section C.1.4. Detections of BEHP in actual sediment samples from sampling events 2 and 3 are therefore suspect and likely due to laboratory artifacts.

C.3 EXTERNAL REFERENCE SAMPLES

External reference samples were submitted to the laboratories by the Project Quality Control Officer. These samples were supplied by Environmental Resource Associates (ERA), Arvada, Colorado, with certified analyses of target parameters. External reference samples were selected by the project quality control officer to match specific method analyses, expected concentration ranges, and sample matrices as closely as possible. The analytical results supplied with the reference samples were not disclosed to the individual laboratories. Samples were submitted a total of five times on a quarterly basis throughout the study. A summary of the results of comparisons between laboratory performance and ERA results for selected constituents is presented in Table C.5.1. Results of each quarter are presented in Tables C.5.2 through C.5.6.

C.3.1 First Quarter ERA Quality Control Samples, 1988

All laboratory reported concentrations were within the advisory ranges of the external reference samples except for arsenic, semi-volatiles (1,2,3-trichlorobenzene), and pesticides (gamma-BHC and PCBs, Aroclor 1242). The advisory range is the range of values that an experienced laboratory can expect to attain using the most precise methods and equipment. In determining advisory ranges, ERA considers both the parameter and the most commonly used method of analysis for the parameter. The arsenic value was outside the advisory range, but was determined to be an acceptable level of performance by the individual laboratory. True and advisory values for ERA organic quality control samples (volatiles, semi-volatiles, pesticides and PCBs, and herbicides) are based on analytical results from applicable EPA reference methods. True values represent 100% recoveries for the analyses. Since many organic analytical methods do not yield 100% recoveries, ERA advisory ranges reflect typical recoveries from water samples for the applicable EPA methodologies. The semi-volatile and pesticides and PCBs values were within an acceptable level of performance by the laboratory.

C.3.2 Second Quarter ERA Quality Control Samples

Laboratory reported values were within the advisory ranges except for the conventional constituents (BOD and TKN), and organic quality control samples such as volatiles (chloroform) and semi-volatiles (acenaphthene, benzo(a)pyrene, 2-chloronaphthalene, 1,3-dichlorobenzene and hexachlorobutadiene). The conventional constituent values were within acceptable levels of performance. The organic sample values were low due to laboratory contamination problems experienced during sample preparation.

C.3.3 Third Quarter ERA Quality Control Samples

Laboratory reported values outside the advisory ranges were for conventional constituents (TKN, ammonia, and phosphate) and organic quality control samples including:

1) Semi-volatiles (hexachloroethane, 1,2,4-trichlorobenzene, 2-chloronaphthalene, acenaphthylene)
2) Pesticides (aldrin and heptachlor epoxide)
3) PCBs (Aroclor 1242)

The pesticides and PCBs true values were near or below the detection limits for the laboratory, which caused recovery values to be unattainable by the laboratory.

C.3.4 Fourth Quarter ERA Quality Control Samples

Laboratory reported values were within the advisory ranges except for trace metals (arsenic, mercury, selenium, and silver), conventional constituents (ammonia, nitrate, phosphate), and organic quality control samples including semi-volatiles (1,4-dichlorobenzene and bis(2-chloroisopropyl)ether), PCBs (Aroclor 1221), and herbicides (2,4-D and 2,4,5-TP). The true values for PCBs and herbicides were below the detection limits for the laboratory and recovery values were unattainable. The herbicides ERA sample was no longer analyzed because the concentration levels of the analyte were always below laboratory detection limits. Due to complications during sample preparation for the metals analysis, low recoveries were reported by the laboratory. The conventional constituent values were acceptable levels of performance.

C.3.5 First Quarter ERA Quality Control Samples, 1989

Laboratory reported values were within the advisory ranges except for trace metals (lead and cadmium), and the organic quality control samples: pesticides (endrin aldehyde) and PCBs (Aroclor 1221). The concentration of endrin aldehyde and Aroclor 1221 were below the laboratory detection limits. The conventional constituent values and the trace metal values were acceptable levels of performance.

C.4 CONCLUSIONS

In summary, the QA/QC data are of acceptable quality according to the current EPA guidelines for laboratory analyses. Based on this QA/QC evaluation, the chemical data (water and sediment) collected in this program are therefore considered of good and reliable quality.

The precision of the data, represented by the relative percent difference (RPD), was evaluated for both field and laboratory duplicates. For field duplicates collected during wet and dry weather periods, the RPD ranged from 0 to 100 percent with an associated mean of 27 percent. For laboratory duplicates, the RPD ranged from 0 to 29 percent (mean of 6 percent) for dry weather samples, and 0 to 40 percent (mean of 16 percent) for wet weather samples. Results of field duplicate samples are an indication of overall field variability, and precision of field sampling techniques and laboratory analyses. As such, the results of field duplicates show more variability than laboratory duplicates, which measure only the precision of laboratory methods.

The accuracy of the data is represented by the results of (1) matrix spike recoveries, and (2) external reference standards. Matrix spike recoveries for all constituents were within acceptable limits. Based on the results of five rounds of external reference standards, most of the metals concentrations (arsenic, cadmium, chromium, copper, lead, mercury, nickel, and zinc) and other conventional pollutants (TKN, nitrate, phosphate, BOD, and total suspended solids) were within the "true" concentrations, therefore indicating that they are reliable values. It is important to note that cadmium, chromium, copper, lead, nickel, and zinc are the five metals used for estimates of metals loads to the Bay. For selenium and silver, however, the actual measured concentrations appear to underestimate the "true" concentrations by about 10 to 30 percent. These two metals were not used in the loading estimates, and were consistently found at low levels with a few values above the detection limit.

APPENDIX C.1

PRECISION OF LABORATORY DUPLICATES

Table C.1-1 Dry Weather 1

CHEMICAL GROUP	ANALYSIS METHOD	SAMPLE ID. PRIMARY	SAMPLE ID. DUPLICATE	STATION No.	SAMPLING EVENT	ANALYTES	MATRIX	UNITS	CONCENTRATION PRIMARY	CONCENTRATION DUPLICATE	RPD (%)	DATE SAMPLED
Chlorinated Herbicides	SW8150	03-137-1	03-137-11	S1	DW#1	2,4-D	WATER	ug/L	13	13	0	27-Aug-88
						Dicamba			5.1	4.9	4	
TOX	SW9020	03-137-1	03-137-12	S1	DW#1	TOX	WATER	mg/L	0.08	0.08	0	27-Aug-88

Table C.1-2 Dry Weather 2

CHEMICAL GROUP	ANALYSIS METHOD	SAMPLE ID. PRIMARY	SAMPLE ID. DUPLICATE	STATION No.	SAMPLING EVENT	ANALYTES	MATRIX	UNITS	CONCENTRATION PRIMARY	CONCENTRATION DUPLICATE	RPD (%)	DATE SAMPLED
METALS	SW6010	2274-5	2274-5	S1	DW#2	Copper	WATER	mg/L	0.051	0.052	2	31-Mar-88
						Lead		mg/L	0.0006	0.0008	29	
						Mercury		mg/L	0.0003	ND	-	
						Silver		mg/L	0.0013	0.0012	8	
						Zinc		mg/L	0.003	0.003	0	
Organophos. Pesticides	SW8140	S8-04-002-04	S8-04-002-04	S1	DW#2	Organophos. Pesticides	WATER	mg/L	ND	ND	-	31-Mar-88
NH3N	350.1	2274-4	2274-5	S4	DW#2	NH3N	WATER	ug/L	110	115	4	31-Mar-88
TKN	351.2	2274-4	2274-5	S4	DW#2	TKN	WATER	ug/L	690	720	4	31-Mar-88
TOC	415.1	2274-4	2274-5	S4	DW#2	TOC	WATER	ug/L	11400	11100	3	31-Mar-88
TKN	351.2	2274-5	2274-5	S4	DW#2	TKN	WATER	mg/L	2.2	2.2	0	31-Mar-88
BOD	405.1	2274-5	2274-5	S4	DW#2	BOD	WATER	mg/L	>15	>15	-	31-Mar-88
TSS	160.2	2274-5	2274-5	S4	DW#2	TSS	WATER	mg/L	20	22	10	31-Mar-88
pH	E150.1	2274-5	2274-5	S4	DW#2	pH	WATER	-	8.1	8.1	0	31-Mar-88
Pesticides & PCBs	E608	2274-5	2274-5	S4	DW#2	Pesticides/PCBs	WATER	ug/L	ND	ND	-	31-Mar-88
Chlorinated Herbicides	SW8150	04-029-8	04-029-9	S1	DW#2	Chlorinated Herbicides	WATER	ug/L	ND	ND	-	31-Mar-88

Table C.1-3 Dry Weather 4

CHEMICAL GROUP	ANALYSIS METHOD	SAMPLE ID. PRIMARY	SAMPLE ID. DUPLICATE	STATION No.	SAMPLING EVENT	ANALYTES	MATRIX	UNITS	CONCENTRATION PRIMARY	CONCENTRATION DUPLICATE	RPD (%)	DATE SAMPLED
Chlorinated Herbicides	SW8150	08-610-08	08-610-11	S3	DW#4	Chlorinated Herbicides	WATER	ug/L	ND	ND	-	23-Aug-88
Chlorinated Herbicides	SW8150	08-610-06	08-610-13	S1	DW#4	Chlorinated Herbicides	WATER	ug/L	ND	ND	-	23-Aug-88
Polynuclear Aromatic Hydrocarbons (PAH)	E610	S8-08-261-03A	S8-08-261-03AD	S5	DW#4	PAH Compounds	WATER	ug/L	ND	ND	-	23-Aug-88

Table C.1-4 Dry Weather 5

CHEMICAL GROUP	ANALYSIS METHOD	SAMPLE ID. PRIMARY	SAMPLE ID. DUPLICATE	STATION No.	SAMPLING EVENT	ANALYTES	MATRIX	UNITS	CONCENTRATION PRIMARY	CONCENTRATION DUPLICATE	RPD (%)	DATE SAMPLED
TOX	9020	12-322-4	12-322-14	S3	DW#5	TOX	WATER	mg/L	ND	ND	-	24-Dec-88
Chlorinated Herbicides	SW8150	12-322-4	12-322-14	S3	DW#5	Chlorinated Herbicides	WATER	ug/L	ND	ND	-	24-Dec-88

Table C.1-5 Dry Weather 6

CHEMICAL GROUP	ANALYSIS METHOD	SAMPLE ID. PRIMARY	SAMPLE ID. DUPLICATE	STATION No.	SAMPLING EVENT	ANALYTES	MATRIX	UNITS	CONCENTRATION PRIMARY	CONCENTRATION DUPLICATE	RPD (%)	DATE SAMPLED
TOC	E415.2	02-059-3	02-059-6	S3	DW#6	TOC	WATER	mg/L	1.7	1.6	6	2-Feb-89
TOX	9020	02-059-3	02-059-6	S3	DW#6	TOX	WATER	mg/L	<0.025	<0.025	-	2-Feb-89
METALS	SW6010	T-3531	T-3531	S3	DW#6	Arsenic	WATER	mg/L	ND	ND	-	2-Feb-89
						Cadmium		mg/L	ND	0.0006	-	
						Chromium, Total		mg/L	0.003	0.003	0	
						Chromium, Hex		mg/L	ND	ND	-	
						Copper		mg/L	ND	ND	-	
						Lead		mg/L	ND	ND	-	
						Mercury		mg/L	ND	ND	-	
						Nickel		mg/L	ND	0.002	-	
						Selenium		mg/L	0.0008	0.0009	12	
						Silver		mg/L	ND	ND	-	
						Zinc		mg/L	0.008	0.006	29	
BOD	405.1	T-3531	T-3531	S3	DW#6	BOD	WATER	mg/L	2.6	2.4	8	2-Feb-89
Turbidity	180.1	T-3531	T-3531	S3	DW#6	Turbidity	WATER	mg/L	4.6	4.8	4	2-Feb-89
Hardness	200.7	T-3531	T-3531	S3	DW#6	Hardness	WATER	mg/L	360	370	3	2-Feb-89
TKN	351.2	T-3531	T-3531	S3	DW#6	TKN	WATER	mg/L	ND	ND	-	2-Feb-89
TSS	160.2	T-3531	T-3531	S3	DW#6	TSS	WATER	mg/L	ND	ND	-	2-Feb-89

Table C.1-6 Dry Weather 7

CHEMICAL GROUP	ANALYSIS METHOD	SAMPLE ID. PRIMARY	SAMPLE ID. DUPLICATE	STATION No.	SAMPLING EVENT	ANALYTES	MATRIX	UNITS	CONCENTRATION PRIMARY	CONCENTRATION DUPLICATE	RPD (%)	DATE SAMPLED
TOC	415.2	04-195-3	04-195-6	S3	DW#7	TOC	WATER	mg/L	2.3	2.3	0	7-Apr-89
TOX	9020	04-195-3	04-195-6	S3	DW#7	TOX	WATER	mg/L	<0.025	<0.025	_	

Table C.1-7 Wet Weather 2

CHEMICAL GROUP	ANALYSIS METHOD	SAMPLE ID. PRIMARY	SAMPLE ID. DUPLICATE	STATION No.	SAMPLING EVENT	ANALYTES	MATRIX	UNITS	CONCENTRATION PRIMARY	CONCENTRATION DUPLICATE	RPD (%)	DATE SAMPLED
METALS	SW6010	T88-3264	T88-3264	S3	WW#2	Arsenic	WATER	mg/L	ND	ND	-	24-Nov-88
						Cadmium		mg/L	0.001	0.0007	35	
						Chromium, Total		mg/L	0.12	0.11	9	
						Chromium, Hex		mg/L	IS	IS	-	
						Copper		mg/L	0.17	0.15	13	
						Lead		mg/L	0.35	0.2	55	
						Mercury		mg/L	0.006	0.002	100	
						Nickel		mg/L	0.22	0.1	75	
						Selenium		mg/L	ND	ND	-	
						Silver		mg/L	0.0002	0.0002	0	
						Zinc		mg/L	0.45	0.4	12	
TKN	351.2	T88-3264	T88-3264	S3	WW#2	TKN	WATER	mg/L	5	5.3	6	24-Nov-88
Ammonia (as N)	350.1	T88-3264	T88-3264	S3	WW#2	Ammonia (as N)	WATER	mg/L	ND	ND	-	24-Nov-88
Nitrate (as N)	353.2	T88-3264	T88-3264	S3	WW#2	Nitrate (as N)	WATER	mg/L	0.62	0.65	5	24-Nov-88
Nitrite (as N)	354.1	T88-3264	T88-3264	S3	WW#2	Nitrite (as N)	WATER	mg/L	0.025	0.024	4	24-Nov-88
Hardness	200.7	T88-3264	T88-3264	S3	WW#2	Hardness	WATER	mg/L	180	180	0	24-Nov-88
Turbidity	180.1	T88-3264	T88-3264	S3	WW#2	Turbidity	WATER	mg/L	910	890	2	24-Nov-88
BOD	405.1	T88-3264	T88-3264	S3	WW#2	BOD	WATER	mg/L	4	IS	-	24-Nov-88
TSS	160.2	T88-3264	T88-3264	S3	WW#2	TSS	WATER	mg/L	1700	1700	0	24-Nov-88
Phosphorus	365.3	T88-3264	T88-3264	S3	WW#2	Phosphorus	WATER	mg/L	1.15	1.04	10	24-Nov-88
Pesticides & PCBs	E608	T88-3264	T88-3264	S3	WW#2	Pesticides & PCBs	WATER	ug/L	ND	ND	-	24-Nov-88

Table C.1-8 Wet Weather 3

CHEMICAL GROUP	ANALYSIS METHOD	SAMPLE ID. PRIMARY	SAMPLE ID. DUPLICATE	STATION No.	SAMPLING EVENT	ANALYTES	MATRIX	UNITS	CONCENTRATION PRIMARY	CONCENTRATION DUPLICATE	RPD (%)	DATE SAMPLED
TOC	415.2	01-539-5	01-539-6	S3	WW#3	TOC	WATER	mg/L	20	15	29	23-Jan-89
TOX	9020	01-539-5	01-539-6	S3	WW#3	TOX	WATER	mg/L	<0.02	<0.02	-	23-Jan-89

Table C.1-9 Wet Weather 4

CHEMICAL GROUP	ANALYSIS METHOD	SAMPLE ID. PRIMARY	SAMPLE ID. DUPLICATE	STATION No.	SAMPLING EVENT	ANALYTES	MATRIX	UNITS	CONCENTRATION PRIMARY	CONCENTRATION DUPLICATE	RPD (%)	DATE SAMPLED
Polynuclear Aromatic Hydrocarbons (PAH)	E610	045596-0005	045596-0005DU	L5	WW#4	Benzo(b)fluoranthene	WATER	ug/L	0.28	0.26	7	5-Feb-89
TOC	E415.2	02-154-5	02-154-13	L5	WW#4	TOC	WATER	mg/L	11	11	0	5-Feb-89
TOX	9020	02-154-5	02-154-13	L5	WW#4	TOX	WATER	mg/L	ND	ND	-	5-Feb-89

Table C.1-10 Wet Weather 5

CHEMICAL GROUP	ANALYSIS METHOD	SAMPLE ID. PRIMARY	SAMPLE ID. DUPLICATE	STATION No.	SAMPLING EVENT	ANALYTES	MATRIX	UNITS	CONCENTRATION PRIMARY	CONCENTRATION DUPLICATE	RPD (%)	DATE SAMPLED
Polynuclear Aromatic Hydrocarbons (PAH)	E610	045688-0001	045688-0001DU	L1	WW#5	Fluoranthene	WATER	ug/L	2.4	2.6	8	10-Feb-89
						Pyrene		ug/L	2	2.2	10	
						Benzo(a)anthracene		ug/L	0.56	0.6	7	
						Benzo(b)fluoranthene		ug/L	0.78	0.86	10	
						Benao(k)fluoranthene		ug/L	0.34	0.37	8	
						Benzo(a)pyrene		ug/L	0.91	1	9	
						Benzo(ghi)perylene		ug/L	1.3	1.5	14	
						Indeno(1,2,3-c,d)pyrene		ug/L	1.4	1.2	15	
TOC	E415.2	02-388-1	02-388-14	L1	WW#5	TOC	WATER	mg/L	44	44	0	10-Feb-89
TOX	9020	02-388-1	02-388-14	L1	WW#5	TOX	WATER	mg/L	0.06	0.04	40	10-Feb-89

Table C.1-11 Wet Weather 6

CHEMICAL GROUP	ANALYSIS METHOD	SAMPLE ID. PRIMARY	SAMPLE ID. DUPLICATE	STATION No.	SAMPLING EVENT	ANALYTES	MATRIX	UNITS	CONCENTRATION PRIMARY	CONCENTRATION DUPLICATE	RPD (%)	DATE SAMPLED
Polynuclear Aromatic Hydrocarbons (PAH)	E610	46005-0006-SA	46005-0006-DU	S1	WW#6	PNA	WATER	ug/L	0.36	0.31	15	2-Mar-89
TOC	415.2	03-115-1	03-115-12	L1	WW#6	TOC	WATER	mg/L	260	260	0	2-Mar-89

Table C.1-12 Wet Weather 7

CHEMICAL GROUP	ANALYSIS METHOD	SAMPLE ID. PRIMARY	SAMPLE ID. DUPLICATE	STATION No.	SAMPLING EVENT	ANALYTES	MATRIX	UNITS	CONCENTRATION PRIMARY	CONCENTRATION DUPLICATE	RPD (%)	DATE SAMPLED
TOC	415.2	03-665-7	03-665-11	S1	WW#7	TOC	WATER	mg/L	8.3	8.4	1	25-Mar-89

Table C.1-13 Sediment 1

CHEMICAL GROUP	ANALYSIS METHOD	SAMPLE ID. PRIMARY	SAMPLE ID. DUPLICATE	STATION No.	SAMPLING EVENT	ANALYTES	MATRIX	UNITS	CONCENTRATION		RPD (%)	DATE SAMPLED
									PRIMARY	DUPLICATE		
TOC	415.2	2274-5	2274-5	S4	Sed#1	TOC	SOIL	ug/g	11400	11100	3	31-Mar-89
Ammonia	351.2	2274-5	2274-5	S4	Sed#1	Ammonia	SOIL	ug/g	110	115	4	31-Mar-89
TKN	350.1	2274-5	2274-5	S4	Sed#1	TKN	SOIL	ug/g	690	720	4	31-Mar-89
Metals	SW6010	2274-5	2274-5	S4	Sed#1	Arsenic	SOIL	ug/g	7.9	8.8	11	31-Mar-89
						Cadmium		ug/g	0.37	0.32	14	
						Chromium, Total		ug/g	80	83	4	
						Copper		ug/g	35	33	6	
						Lead		ug/g	28	28	0	
						Mercury		ug/g	0.14	0.16	13	
						Nickel		ug/g	85	82	4	
						Selenium		ug/g	0.59	0.49	19	
						Silver		ug/g	1.2	1.1	9	
						Zinc		ug/g	100	110	10	
Pesticides & PCBs	SW8080	2274-5	2274-5	S4	Sed#1	gamma-Chlodane	SOIL	ug/g	13	ND	NA	31-Mar-89
						alpha-Chlordane			8.4	3.5	82	
						4,4'-DDD			24	7	110	
						4,4'-DDE			14	8.5	49	
						4,4'-DDT			8.9	11	21	
						PCBs			80	44	58	

APPENDIX C.2
PRECISION OF FIELD DUPLICATES

Table C.2-1 Dry Weather 1

CHEMICAL GROUP	ANALYSIS METHOD	SAMPLE ID. PRIMARY	SAMPLE ID. DUPLICATE	STATION No.	SAMPLING EVENT	ANALYTES	MATRIX	UNITS	CONCENTRATION		(%)	DATE SAMPLED
									PRIMARY	DUPLICATE		
TOX	9020	03-137-1	03-137-11	S1	DW#1	TOX	WATER	mg/L	0.08	0.08	0	27-Feb-88
Chlorinated Herbicides	SW8150	03-137-1	03-137-11	S1	DW#1	2,4-D	WATER	ug/L	13	13	0	
						DICAMBA		ug/L	5.1	4.9	4	
TOX	9020	03-137-2	03-137-12	S2	DW#1	TOX	WATER	mg/L	<0.025	0.08	NA	27-Feb-88
Chlorinated Herbicides	SW8150	03-137-2	03-137-12	S2	DW#1	2,4-D	WATER	ug/L	ND	11	NA	
						DICAMBA		ug/L	ND	4.2	NA	
Chlorinated Herbicides	SW8150	E88-04-029	E88-04-029	S1	DW#1	Chlor. Herbicides	WATER	ug/L	ND	ND	NA	27-Feb-88

Table C.2-2 Dry Weather 2

CHEMICAL GROUP	ANALYSIS METHOD	SAMPLE ID. PRIMARY	SAMPLE ID. DUPLICATE	STATION No.	SAMPLING EVENT	ANALYTES	MATRIX	UNITS	CONCENTRATION PRIMARY	CONCENTRATION DUPLICATE	(%)	DATE SAMPLED
Metals	SW6010	2274-5	2274-5	S1	DW#2	Copper	WATER	mg/L	0.051	0.052	2	31-Mar-88
						Lead			0.0006	0.0008	29	
						Mercury			0.0003	ND	NA	
						Selenium			ND	ND	NA	
						Silver			0.0013	0.0012	8	
						Zinc			0.003	0.003	0	
Polynuclear Aromatic Hydrocarbons (PAH)	SW8100	S8-04-002-04	S8-04-002-04	S1	DW#2	PAH Compounds	WATER	ug/L	ND	ND	NA	31-Mar-88
Organo. Pesticides	SW8140	S8-04-002-02	S8-04-002-02	S1	DW#2	Organo. Pesticides	WATER	ug/L	ND	ND	NA	31-Mar-88
Chlorinated Herbicides	SW8150	04-029-8	04-029-09	S1	DW#2	Chlorinated Herbicides	WATER	ug/L	ND	ND	NA	31-Mar-88

Table C.2-3 Dry Weather 3

CHEMICAL GROUP	ANALYSIS METHOD	SAMPLE ID. PRIMARY	SAMPLE ID. DUPLICATE	STATION No.	SAMPLING EVENT	ANALYTES	MATRIX	UNITS	CONCENTRATION PRIMARY	CONCENTRATION DUPLICATE	(%)	DATE SAMPLED
Chlorinated Herbicides	SW8150	05-399-04	05-399-05	S4	DW#3	2,4-D	WATER	ug/L	61	56	9	12-May-88
						Dicamba			47	48	2	
Metals	SW6010	2376	2376	S4	DW#3	Copper	WATER	mg/L	0.008	0.01	22	12-May-88
						Lead			0.0026	0.0028	7	
						Mercury			ND	ND	NA	
						Selenium			ND	ND	NA	
						Silver			0.0034	0.0033	3	
						Zinc			0.023	0.026	12	
BOD	405.1	2376	2376	S4	DW#3	BOD	WATER	mg/L	6	6	0	12-May-88
TKN	351.2	2376	2376	S4	DW#3	TKN	WATER	mg/L	1.7	1.7	0	12-May-88
TSS	160.2	2376	2376	S4	DW#3	TSS	WATER	mg/L	30	39	26	12-May-88
pH	E150.1	2376	2376	S4	DW#3	pH	WATER	mg/L	7.5	7.7	3	12-May-88
Total Coliform	909C	2376	2376	S4	DW#3	Total Coliform	WATER	mg/L	900000	>1600000	NA	12-May-88
Fecal Coliform	909A	2376	2376	S4	DW#3	Fecal Coliform	WATER	mg/L	4000	7000	55	12-May-88
TOC	415.1	2376	2376	S4	DW#3	TOC	WATER	mg/L	33	22	40	12-May-88
Polynuclear Aromatic	E610	S8-06-165-04	S8-06-165-04D	S4	DW#3	Polynuclear Aromatic	WATER	ug/L	ND	ND	NA	12-May-88

Table C.2-4 Dry Weather 4

CHEMICAL GROUP	ANALYSIS METHOD	SAMPLE ID. PRIMARY	SAMPLE ID. DUPLICATE	STATION No.	SAMPLING EVENT	ANALYTES	MATRIX	UNITS	CONCENTRATION PRIMARY	CONCENTRATION DUPLICATE	(%)	DATE SAMPLED
TOX	9020	08-610-1	08-610-3	S3	DW#4	TOX	WATER	mg/L	ND	ND	NA	23-Aug-88
Chlorinated Herbicides	SW8150	08-610-1	08-610-3	S3	DW#4	Chlorinated Herbicides	WATER	ug/L	ND	ND	NA	23-Aug-88
Total Coliform	909C	S3	S5	S3	DW#4	Total Coliform	WATER	MPN/100	>2400	>2400	NA	23-Aug-88
Fecal Coliform	909A	S3	S5	S3	DW#4	Fecal Coliform	WATER	MPN/100	70	70	0	23-Aug-88
Pesticides & PCBs	E608	S3	S5	S3	DW#4	Pesticides & PCBs	WATER	ug/L	ND	ND	NA	23-Aug-88
Metals	SW6010	S3	S5	S3	DW#4	Copper	WATER	mg/L	0.011	0.007	44	23-Aug-88
						Lead			ND	0.014	NA	
						Mercury			0.0027	0.0025	8	
						Selenium			0.0023	0.0018	24	
						Silver			0.0024	0.003	22	
						Zinc			0.009	0.014	43	
Nitrite	354.1	S3	S5	S3	DW#4	Nitrite	WATER	mg/L	2	1.8	11	23-Aug-88
Nitrate	353.2	S3	S5	S3	DW#4	Nitrate	WATER	mg/L	ND	ND	NA	23-Aug-88
TKN	351.2	S3	S5	S3	DW#4	TKN	WATER	mg/L	1	3	100	23-Aug-88
TSS	160.2	S3	S5	S3	DW#4	TSS	WATER	mg/L	8.5	5.5	43	23-Aug-88
BOD	405.1	S3	S5	S3	DW#4	BOD	WATER	mg/L	7	5	33	23-Aug-88
Polynuclear Aromatic Hydrocarbons (PAH)	E610	S3	S5	S3	DW#4	PAH Compounds	WATER	ug/L	ND	ND	NA	23-Aug-88

Table C.2-5 Dry Weather 5

CHEMICAL GROUP	ANALYSIS METHOD	SAMPLE ID. PRIMARY	SAMPLE ID. DUPLICATE	STATION No.	SAMPLING EVENT	ANALYTES	MATRIX	UNITS	CONCENTRATION PRIMARY	CONCENTRATION DUPLICATE	(%)	DATE SAMPLED
Polynuclear Aromatic Hydrocarbons (PAH)	E610	44880-0003	44880-0003DU	S3	DW#5	PAH Compounds	WATER	ug/L	ND	ND	NA	13-Dec-88
TOX	9020	12-322-3	12-322-4	S3	DW#5	TOX	WATER	mg/L	ND	ND	NA	13-Dec-88
Chlorinated Herbicides	SW8150	12-322-3	12-322-4	S3	DW#5	Chlorinated Herbicides	WATER	mg/L	ND	ND	NA	13-Dec-88
Total Coliform	909C	S3	S5	S3	DW#5	Total Coliform	WATER	MPN/100	>2400	>2400	NA	13-Dec-88
Fecal Coliform	909A	S3	S5	S3	DW#5	Fecal Coliform	WATER	MPN/100	1100	460	82	13-Dec-88
Pesticides & PCBs	E608	T88-3340	T88-3340	S3	DW#5	Pesticides & PCBs	WATER	ug/L	ND	ND	NA	13-Dec-88
Metals	SW6010	T88-3340	T88-3340	S3	DW#5	Chromium, Hex	WATER	mg/L	ND	ND	NA	13-Dec-88
						Copper			0.003	ND	NA	
						Lead			ND	ND	NA	
						Mercury			ND	ND	NA	
						Selenium			0.0003	ND	NA	
						Silver			ND	ND	NA	
						Zinc			0.026	0.014	60	
TKN	351.2	T88-3340	T88-3340	S3	DW#5	TKN	WATER	mg/L	ND	ND	NA	13-Dec-88
BOD	405.1	T88-3340	T88-3340	S3	DW#5	BOD	WATER	mg/L	ND	2	NA	13-Dec-88
TSS	160.2	T88-3340	T88-3340	S3	DW#5	TSS	WATER	mg/L	ND	ND	NA	13-Dec-88
Hardness	200.7	T88-3340	T88-3340	S3	DW#5	Hardness	WATER	mg/L	340	320	6	13-Dec-88
Turbidity	180.1	T88-3340	T88-3340	S3	DW#5	Turbidity	WATER	mg/L	6	5	18	13-Dec-88

Table C.2-6 Dry Weather 6

CHEMICAL GROUP	ANALYSIS METHOD	SAMPLE ID. PRIMARY	SAMPLE ID. DUPLICATE	STATION No.	SAMPLING EVENT	ANALYTES	MATRIX	UNITS	CONCENTRATION PRIMARY	CONCENTRATION DUPLICATE	(%)	DATE SAMPLED
Polynuclear Aromatic Hydrocarbons (PAH)	E610	045559-0003	045559-0005	S3	DW#6	PAH Compounds	WATER	ug/L	ND	ND	NA	2-Feb-89
Total Coliform	909C	S3	S5	S3	DW#6	Total Coliform	WATER	MPN/100	24000	11000	74	2-Feb-89
Fecal Coliform	909A	S3	S5	S3	DW#6	Fecal Coliform	WATER	MPN/100	43	23	61	2-Feb-89
TOC	415.1	02-059-3	02-059-5	S3	DW#6	TOC	WATER	mg/L	1.7	1.7	0	2-Feb-89
TOX	9020	02-059-3	02-059-5	S3	DW#6	TOX	WATER	mg/L	<0.025	<0.025	NA	2-Feb-89
Pesticides & PCBs	E608	T-3531	T-3531	S3	DW#6	Pesticides & PCBs	WATER	mg/L	ND	ND	NA	2-Feb-89
Metals	SW6010	T-3531	T-3531	S3	DW#6	Arsenic	WATER	mg/L	ND	ND	NA	2-Feb-89
						Cadmium			ND	0.0002	NA	
						Chromium,Total			0.003	0.003	0	
						Chromium, Hex			ND	ND	NA	
						Copper			ND	0.004	NA	
						Lead			ND	0.004	NA	
						Mercury			ND	ND	NA	
						Nickel			ND	ND	NA	
						Selenium			0.0008	0.0005	46	
						Silver			ND	ND	NA	
						Zinc			0.008	0.01	22	
BOD	405.1	T-3531	T-3531	S3	DW#6	BOD	WATER	mg/L	2.6	1.9	31	2-Feb-89
Turbidity	180.1	T-3531	T-3531	S3	DW#6	Turbidity	WATER	mg/L	4.6	3	42	2-Feb-89
Hardness	200.7	T-3531	T-3531	S3	DW#6	Hardness	WATER	mg/L	360	360	0	2-Feb-89
TKN	351.2	T-3531	T-3531	S3	DW#6	TKN	WATER	mg/L	ND	ND	NA	2-Feb-89
TSS	160.2	T-3531	T-3531	S3	DW#6	TSS	WATER	mg/L	ND	ND	NA	2-Feb-89

Table C.2-7 Dry Weather 7

CHEMICAL GROUP	ANALYSIS METHOD	SAMPLE ID. PRIMARY	SAMPLE ID. DUPLICATE	STATION No.	SAMPLING EVENT	ANALYTES	MATRIX	UNITS	CONCENTRATION PRIMARY	CONCENTRATION DUPLICATE	(%)	DATE SAMPLED
Total Coliform	909C	S3	S5	S3	DW#7	Total Coliform	WATER	MPN/100	4600	2400	63	7-Apr-89
Fecal Coliform	909A	S3	S5	S3	DW#7	Fecal Coliform	WATER	MPN/100	400	460	14	7-Apr-89
Pesticides & PCBs	E608	T-3839	T-3839	S3	DW#7	Pesticides & PCBs	WATER	mg/L	ND	ND	NA	7-Apr-89
Metals	SW6010	T-3839	T-3839	S3	DW#7	Arsenic	WATER	mg/L	0.001	0.001	0	7-Apr-89
						Cadmium			ND	0.0031	NA	
						Chromium,Total			0.003	ND	NA	
						Chromium, Hex			ND	ND	NA	
						Copper			0.004	0.003	29	
						Lead			ND	ND	NA	
						Mercury			ND	ND	NA	
						Nickel			0.002	ND	NA	
						Selenium			ND	ND	NA	
						Silver			0.002	ND	NA	
						Zinc			0.01	0.015	40	
TKN	351.2	T-3839	T-3839	S3	DW#7	TKN	WATER	mg/L	ND	ND	NA	7-Apr-89
TSS	160.2	T-3839	T-3839	S3	DW#7	TSS	WATER	mg/L	2.4	2.8	15	7-Apr-89
BOD	405.1	T-3839	T-3839	S3	DW#7	BOD	WATER	mg/L	1.9	1.8	5	7-Apr-89
Hardness	200.7	T-3839	T-3839	S3	DW#7	Hardness	WATER	mg/L	290	308	6	7-Apr-89
Turbidity	180.1	T-3839	T-3839	S3	DW#7	Turbidity	WATER	mg/L	4.9	3.5	33	7-Apr-89
TOC	415.1	04-195-3	04-195-5	S3	DW#7	TOC	WATER	mg/L	2.3	2.4	4	7-Apr-89
TOX	9020	04-195-3	04-195-5	S3	DW#7	TOX	WATER	mg/L	ND	ND	NA	7-Apr-89
Polynuclear Aromatic Hydrocarbons (PAH)	E610	046590-0003	046590-0005	S3	DW#7	PAH Compounds	WATER	ug/L	ND	ND	NA	7-Apr-89

Table C.2-8 Wet Weather 2

CHEMICAL GROUP	ANALYSIS METHOD	SAMPLE ID. PRIMARY	SAMPLE ID. DUPLICATE	STATION No.	SAMPLING EVENT	ANALYTES	MATRIX	UNITS	CONCENTRATION PRIMARY	CONCENTRATION DUPLICATE	(%)	DATE SAMPLED
Volatile Organics	E624	8811103-09	8811103-11	S3	WW#2	Volatile Organics	WATER	ug/L	ND	ND	NA	24-Nov-88
Semivolatile Organics	E 625	8811103-09	8811103-11	S3	WW#2	Semivolatile Organics	WATER	ug/L	ND	ND	NA	24-Nov-88
METALS	SW6010			S3	WW#2	Arsenic	WATER	mg/L	ND	ND	NA	24-Nov-88
						Cadmium		mg/L	0.004	0.002	67	
						Chromium,Total		mg/L	0.14	0.065	73	
						Chromium, Hex		mg/L	IS	IS	NA	
						Copper		mg/L	0.19	0.072	90	
						Lead		mg/L	0.25	0.13	63	
						Mercury		mg/L	0.004	0.003	29	
						Nickel		mg/L	0.24	0.1	82	
						Selenium		mg/L	ND	ND	NA	
						Silver		mg/L	0.0004	ND	NA	
						Zinc		mg/L	0.91	0.25	84	
TOC	415.1	11-635-9	11-635-11	S3	WW#2	TOC	WATER	mg/L	23	9	88	24-Nov-88
TOX	9020	11-635-9	11-635-11	S3	WW#2	TOX	WATER	mg/L	0.029	0.055	62	24-Nov-88
Chlorinated Herbicides	SW8150	11-635-9	11-635-11	S3	WW#2	Chlorinated Herbicides	WATER	ug/L	ND	ND	NA	24-Nov-88
Pesticides & PCB's	E 608	S4	S5	S4	WW#2	4,4'-DDE	WATER	ug/L	0.07	0.05	33	24-Nov-88
						4,4'-DDT		ug/L	0.19	0.15	24	
						gamma-chlordane		ug/L	0.1	ND	NA	
						Endosulfan I		ug/L	0.13	ND	NA	
						Endosulfan II		ug/L	0.06	ND	NA	
						Arochlor 1254		ug/L	ND	1.4	NA	
TKN	351.2	T88-3264	T88-3264	S4	WW#2	TKN	WATER	mg/L	1.8	1.6	12	24-Nov-88
Ammonia	350.1	T88-3264	T88-3264	S4	WW#2	Ammonia	WATER	mg/L	ND	ND	NA	24-Nov-88
Nitrite	354.1	T88-3264	T88-3264	S4	WW#2	Nitrite	WATER	mg/L	0.57	0.62	8	24-Nov-88
Nitrate	353.2	T88-3264	T88-3264	S4	WW#2	Nitrate	WATER	mg/L	0.045	0.032	34	24-Nov-88
Hardness	200.7	T88-3264	T88-3264	S4	WW#2	Hardness	WATER	mg/L	230	150	42	24-Nov-88
Turbidity	180.1	T88-3264	T88-3264	S4	WW#2	Turbidity	WATER	mg/L	380	650	52	24-Nov-88
BOD	405.1	T88-3264	T88-3264	S4	WW#2	BOD	WATER	mg/L	12	20	50	24-Nov-88
TSS	160.2	T88-3264	T88-3264	S4	WW#2	TSS	WATER	mg/L	430	1200	94	24-Nov-88
Phosphorus		T88-3264	T88-3264	S4	WW#2	Phosphorus	WATER	mg/L	0.55	0.86	44	24-Nov-88

Table C.2-9 Wet Weather 3

CHEMICAL GROUP	ANALYSIS METHOD	SAMPLE ID. PRIMARY	SAMPLE ID. DUPLICATE	STATION No.	SAMPLING EVENT	ANALYTES	MATRIX	UNITS	CONCENTRATION PRIMARY	CONCENTRATION DUPLICATE	(%)	DATE SAMPLED
Polynuclear Aromatic Hydrocarbons (PAH)	E 610	045459-0004	045459-0005	S3	WW#3	Fluoranthene	WATER	ug/L	0.29	0.26	11	24-Jan-89
						Pyrene		ug/L	0.33	0.32	3	
TOC	415.1	01-539-3	01-539-4	S2	WW#3	TOC	WATER	mg/L	19	19	0	24-Jan-89
TOX	9020	01-539-3	01-539-4	S2	WW#3	TOX	WATER	mg/L	0.04	0.04	0	24-Jan-89
Metals	SW6010	T-3497	T-3497	S2	WW#3	Arsenic	WATER	mg/L	ND	ND	NA	24-Jan-89
						Cadmium		mg/L	0.0006	0.0004	40	
						Chromium,Total		mg/L	0.004	0.003	29	
						Chromium, Hex		mg/L	ND	ND	NA	
						Copper		mg/L	0.003	0.002	40	
						Lead		mg/L	0.001	0.002	67	
						Mercury		mg/L	ND	ND	NA	
						Nickel		mg/L	ND	ND	NA	
						Selenium		mg/L	ND	ND	NA	
						Silver		mg/L	ND	ND	NA	
						Zinc		mg/L	0.14	0.22	44	
TKN	351.2	T-3497	T-3497	S2	WW#3	TKN	WATER	mg/L	1.7	1.5	13	24-Jan-89
BOD	405.1	T-3497	T-3497	S2	WW#3	BOD	WATER	mg/L	13	12	8	24-Jan-89
Pesticides & PCBs	E608	T-3497	T-3497	S2	WW#3	gamma-BHC (Lindane)	WATER	ug/L	0.032	ND	NA	24-Jan-89

Table C.2-10 Wet Weather 4

CHEMICAL GROUP	ANALYSIS METHOD	SAMPLE ID. PRIMARY	SAMPLE ID. DUPLICATE	STATION No.	SAMPLING EVENT	ANALYTES	MATRIX	UNITS	CONCENTRATION PRIMARY	CONCENTRATION DUPLICATE	(%)	DATE SAMPLED
Polynuclear Aromatic Hydrocarbons (PAH)	E 610	045596-0005	045596-0011	L5	WW#4	Benzo(b)fluoranthene	WATER	ug/L	0.28	0.33	16	5-Feb-89
TOC	E 415.2	02-154-5	02-154-11	L5	WW#4	TOC	WATER	mg/L	11	11	0	5-Feb-89
TOX	E 415.2	02-154-5	02-154-11	L5	WW#4	TOX	WATER	mg/L	ND	ND	NA	5-Feb-89
Metals	SW6010	T-3553	T-3553	L5	WW#4	Arsenic	WATER	mg/L	ND	ND	NA	5-Feb-89
						Cadmium		mg/L	0.0028	0.0026	7	
						Chromium,Total		mg/L	0.028	0.011	87	
						Chromium, Hex		mg/L	ND	ND	NA	
						Copper		mg/L	0.032	0.019	51	
						Lead		mg/L	0.05	0.042	17	
						Mercury		mg/L	0.004	0.006	40	
						Nickel		mg/L	0.025	0.021	17	
						Selenium		mg/L	ND	ND	NA	
						Silver		mg/L	ND	ND	NA	
						Zinc		mg/L	0.2	0.18	11	
TKN	351.2	T-3553	T-3553	L5	WW#4	TKN	WATER	mg/L	1.2	1.7	34	5-Feb-89
BOD	405.1	T-3553	T-3553	L5	WW#4	BOD	WATER	mg/L	4.4	4.1	7	5-Feb-89
TSS	160.1	T-3553	T-3553	L5	WW#4	TSS	WATER	mg/L	52	46	12	5-Feb-89
Hardness	200.7	T-3553	T-3553	L5	WW#4	Hardness	WATER	mg/L	45	47	4	5-Feb-89
Turbidity	180.1	T-3553	T-3553	L5	WW#4	Turbidity	WATER	mg/L	73	87	18	5-Feb-89
Pesticides & PCBs	E608	T-3553	T-3553	L5	WW#4	Pesticides & PCBs	WATER	ug/L	0.05	0.05	0	5-Feb-89

Table C.2-11 Wet Weather 5

CHEMICAL GROUP	ANALYSIS METHOD	SAMPLE ID. PRIMARY	SAMPLE ID. DUPLICATE	STATION No.	SAMPLING EVENT	ANALYTES	MATRIX	UNITS	CONCENTRATION PRIMARY	CONCENTRATION DUPLICATE	(%)	DATE SAMPLED
Pesticides & PCBs	E608	T-3573	T-3573	S1	WW#5	Pesticides & PCBs	WATER	ug/L	ND	ND	NA	10-Feb-89
Total Coliform	909C	S1	S5	S1	WW#5	Total Coliform	WATER	MPN/100	>240000	>240000	NA	10-Feb-89
Fecal Coliform	909A	S1	S5	S1	WW#5	Fecal Coliform	WATER	MPN/100	>240000	11000	NA	10-Feb-89
Metals	SW6010	T-3573	T-3573	S1	WW#5	Arsenic	WATER	mg/L	ND	ND	NA	10-Feb-89
						Cadmium		mg/L	0.0035	0.0035	0	
						Chromium,Total		mg/L	0.019	0.019	0	
						Chromium, Hex		mg/L	ND	ND	NA	
						Copper		mg/L	0.032	0.03	6	
						Lead		mg/L	0.032	0.039	20	
						Mercury		mg/L	ND	ND	NA	
						Nickel		mg/L	ND	0.018	NA	
						Selenium		mg/L	ND	ND	NA	
						Silver		mg/L	ND	ND	NA	
						Zinc		mg/L	0.12	0.18	40	
TKN	351.2	T-3573	T-3573	S1	WW#5	TKN	WATER	mg/L	ND	1.8	NA	10-Feb-89
BOD	405.1	T-3573	T-3573	S1	WW#5	BOD	WATER	mg/L	6.7	4	50	10-Feb-89
TSS	160.2	T-3573	T-3573	S1	WW#5	TSS	WATER	mg/L	76	50	41	10-Feb-89
Hardness	200.7	T-3573	T-3573	S1	WW#5	Hardness	WATER	mg/L	60	50	18	10-Feb-89
Turbidity	180.1	T-3573	T-3573	S1	WW#5	Turbidity	WATER	mg/L	69	95	32	10-Feb-89
TOC	415.1	02-388-8	02-388-12	S1	WW#5	TOC	WATER	MPN/100	12	9.8	20	10-Feb-89
TOX	9020	02-388-8	02-388-12	S1	WW#5	TOX	WATER	MPN/100	ND	0.03	NA	10-Feb-89
Polynuclear Aromatic Hydrocarbons (PAH)	E610	45688-0008	45688-0012	S1	WW#5	Benzo(b) fluoranthene	WATER	ug/L	0.16	ND	NA	10-Feb-89

Table C.2-12 Wet Weather 6

CHEMICAL GROUP	ANALYSIS METHOD	SAMPLE ID. PRIMARY	SAMPLE ID. DUPLICATE	STATION No.	SAMPLING EVENT	ANALYTES	MATRIX	UNITS	CONCENTRATION		(%)	DATE SAMPLED
									PRIMARY	DUPLICATE		
Pesticides & PCBs	E608	T-3659	T-3659	L5	WW#6	Pesticides & PCBs	WATER	ug/L	ND	ND	NA	3-Mar-89
Metals	SW6010	T-3659	T-3659	L5	WW#6	Arsenic	WATER	mg/L	ND	ND	NA	3-Mar-89
						Cadmium		mg/L	0.0013	0.0012	8	
						Chromium,Total		mg/L	0.017	0.017	0	
						Chromium, Hex		mg/L	ND	ND	NA	
						Copper		mg/L	0.05	0.05	0	
						Lead		mg/L	0.045	0.05	11	
						Mercury		mg/L	ND	0.0002	NA	
						Nickel		mg/L	0.06	0.05	18	
						Selenium		mg/L	ND	ND	NA	
						Silver		mg/L	ND	ND	NA	
						Zinc		mg/L	0.31	0.32	3	
TKN	351.2	T-3659	T-3659	L5	WW#6	TKN	WATER	mg/L	1.4	2.8	67	3-Mar-89
BOD	405.1	T-3659	T-3659	L5	WW#6	BOD	WATER	mg/L	13	15	14	3-Mar-89
TSS	160.2	T-3659	T-3659	L5	WW#6	TSS	WATER	mg/L	90	94	4	3-Mar-89
Hardness	200.7	T-3659	T-3659	L5	WW#6	Hardness	WATER	mg/L	35	59	51	3-Mar-89
Turbidity	180.1	T-3659	T-3659	L5	WW#6	Turbidity	WATER	mg/L	83	69	18	3-Mar-89
Total Coliform	909C	03-115-1	03-115-8	L5	WW#6	Total Coliform	WATER	MPN/100	46000	110000	82	3-Mar-89
Fecal Coliform	909A	03-115-1	03-115-8	L5	WW#6	Fecal Coliform	WATER	MPN/100	2400	4300	57	3-Mar-89

Table C.2-13 Wet Weather 7

CHEMICAL GROUP	ANALYSIS METHOD	SAMPLE ID. PRIMARY	SAMPLE ID. DUPLICATE	STATION No.	SAMPLING EVENT	ANALYTES	MATRIX	UNITS	CONCENTRATION		(%)	DATE SAMPLED
									PRIMARY	DUPLICATE		
Metals	SW6010	T-3769	T-3769	S1	WW#7	Arsenic	WATER	mg/L	0.004	0.002	67	26-Mar-89
						Cadmium		mg/L	0.0013	0.0015	14	
						Chromium,Total		mg/L	0.027	0.036	29	
						Chromium, Hex		mg/L	ND	ND	NA	
						Copper		mg/L	0.055	0.061	10	
						Lead		mg/L	0.06	0.1	50	
						Mercury		mg/L	0.0002	ND	NA	
						Nickel		mg/L	0.09	0.11	20	
						Selenium		mg/L	ND	ND	NA	
						Silver		mg/L	0.0002	0.0003	40	
						Zinc		mg/L	0.24	0.37	43	
TSS	160.2	T-3769	T-3769	S1	WW#7	TSS	WATER	mg/L	190	220	15	26-Mar-89
BOD	405.1	T-3769	T-3769	S1	WW#7	BOD	WATER	mg/L	10	9.2	8	26-Mar-89
Hardness	200.7	T-3769	T-3769	S1	WW#7	Hardness	WATER	mg/L	48	64	29	26-Mar-89
Turbidity	180.1	T-3769	T-3769	S1	WW#7	Turbidity	WATER	mg/L	97	120	21	26-Mar-89
TOC	415.2	03-665-7	03-665-10	S1	WW#7	TOC	WATER	mg/L	8.3	8.1	2	26-Mar-89

Table C.2-14 Sediment 1

CHEMICAL GROUP	ANALYSIS METHOD	SAMPLE ID. PRIMARY	SAMPLE ID. DUPLICATE	STATION No.	SAMPLING EVENT	ANALYTES	MATRIX	UNITS	CONCENTRATION PRIMARY	CONCENTRATION DUPLICATE	(%)	DATE SAMPLED
Chlorinated Herbicides	SW8150	05-399-9	05-399-10	S4	Sed#1	Chlorinated Herbicides	SOIL	mg/kg	ND	ND	NA	31-Mar-88

Table C.2-15 Sediment 3

CHEMICAL GROUP	ANALYSIS METHOD	SAMPLE ID. PRIMARY	SAMPLE ID. DUPLICATE	STATION No.	SAMPLING EVENT	ANALYTES	MATRIX	UNITS	CONCENTRATION PRIMARY	CONCENTRATION DUPLICATE	(%)	DATE SAMPLED
Chlorinated Herbicides	SW8150	08-610-8	08-610-10	S4	Sed#3	Chlorinated Herbicides	SOIL	mg/kg	ND	ND	NA	23-Aug-88
Pesticides & PCBs	E608	T88-2797	T88-2797	S4	Sed#3	gamma-BHC (lindane)	SOIL	ug/kg	ND	7.8	NA	23-Aug-88
						alpha-Chlordane			10	10	0	
						gamma-chlordane			13	13	0	
						4,4'-DDD			27	55	68	
						4,4'-DDE			8.1	8.6	6	
						4,4'-DDT			37	27	31	
Semivolatile Organics	E625	8808209-03	8808209-05	S4	Sed#3	Semivolatile Organics	SOIL	ug/kg	ND	ND	NA	23-Aug-88
Organophosphorus Pesticides	SW8140	S8-08-261-01	S8-08-261-03	S4	Sed#3	Organophosphorus Pesticides	SOIL	mg/kg	ND	ND	NA	23-Aug-88

Table C.2-16 Sediment 4

CHEMICAL GROUP	ANALYSIS METHOD	SAMPLE ID. PRIMARY	SAMPLE ID. DUPLICATE	STATION No.	SAMPLING EVENT	ANALYTES	MATRIX	UNITS	CONCENTRATION PRIMARY	CONCENTRATION DUPLICATE	(%)
Polynuclear Aromatic Hydcarbons (PAH)	E610	44880-0009	44880-0011	S3	Sed#4	Phenanthrene	SOIL	ug/kg	ND	380	NA
						Fluoranthene			460	780	52
						Pyrene			420	460	9
						Benzo(a)antharcene			130	ND	NA
						Benzo(b)fluoranthene			250	410	48
						Benzo(k)fluoranthene			110	190	53
						Benzo(a)pyrene			230	360	44
Chlorinated Herbicides	SW8150	12-322-9	12-322-11	S3	Sed#4	Chlorinated Herbicides	SOIL	mg/kg	ND	ND	NA
Pesticides & PCBs	E608	T88-3339	T88-3339	S3	Sed#4	alpha-Chlordane	SOIL	ug/kg	13	9.8	28
						gamma-chlordane			20	16	22
						4,4'-DDD			24	17	34
						4,4'-DDE			13	11	17
						4,4'-DDT			25	ND	NA
						PCBs			240	125	63
Metals	SW6010	T88-3339	T88-3339	S3	Sed#4	Copper	SOIL	ug/kg	45	45	0
						Lead			64	86	29
						Mercury			3.6	2.6	32
						Selenium			1	1	0
						Silver			ND	ND	NA
						Zinc			160	150	6

APPENDIX C.3
PRECISION OF MATRIX SPIKE AND MATRIX SPIKE DUPLICATES

Table C.3-1 Dry Weather 1

						MATRIX SPIKE			MATRIX SPIKE DUPLICATE					
CHEMICAL GROUP	SAMPLE MATRIX	SAMPLING EVENT	SAMPLE ID No.	ANALYTES	UNITS	MS CONC.	MS REC. CONC.	MS REC. (%)	MSD CONC.	MSD REC. CONC.	MSD REC (%)	LAB REC. LIMITS (%)	RPD* (%)	LAB/ ANALYSIS DATE
Volatile Organics	WATER	DW#1	S1-2192	Phenol	ug/L	100	34	34	100	39	39	10--43	-14	Anametrix
				2-Chlorophenol	ug/L	100	63	63	100	75	75	13-84	-17	8-Mar-89
				1,4-Dichlorobenzene	ug/L	50	23	46	50	31	62	12--68	-30	
				Nitrosodipropiamine	ug/L	50	32	64	50	36	72	25--96	-12	
				1,2,4-Trichlorobenzene	ug/L	50	26	52	50	32	64	17--70	-21	
				4-Chloro-3-methylphenol	ug/L	100	87	87	100	85	85	10--127	2	
				Acenaphtene	ug/L	50	38	76	50	38	76	27--123	0	
				4-Nitrophenol	ug/L	100	21	21	100	17	17	10--66	21	
				2,4-Dinitrotoluene	ug/L	50	43	86	50	39	78	43--117	10	
				Pentachlorophenol	ug/L	100	67	67	100	51	51	10--151	27	
				Pyrene	ug/L	50	45	90	50	39	78	47-148	14	
METALS	WATER	DW#1	2274-5	Arsenic		-	-	NA	-	-	82	-	10	ToxScan
				Cadmium		-	-	112	-	-	81	-	14	25-May-88
				Chromium		-	-	113	-	-	75	-	4	
				Copper		-	-	112	-	-	89	-	8	
				Lead		-	-	107	-	-	68	-	0	
				Mercury		-	-	92	-	-	125	-	13	
				Nickel		-	-	73	-	-	67	-	4	
				Selenium		-	-	62	-	-	70	-	18	
				Silver		-	-	114	-	-	NA	-	2	
				Zinc		-	-	85	-	-	83	-	4	

* RPD values were calculated by the laboratory.

Table C.3-2 Dry Weather 2

						MATRIX SPIKE			MATRIX SPIKE DUPLICATE					
CHEMICAL GROUP	SAMPLE MATRIX	SAMPLING EVENT	SAMPLE ID No.	ANALYTES	UNITS	MS CONC.	MS REC. CONC.	MS REC. (%)	MSD CONC.	MSD REC. CONC.	MSD REC (%)	LAB REC. LIMITS (%)	RPD* (%)	LAB/ ANALYSIS DATE
METALS	WATER	DW#2	2274-5	Copper		-	-	100	-	-	104	-	2	ToxScan
				Lead		-	-	99	-	-	89	-	28	25-May-88
				Mercury		-	-	111	-	-	104	-	NA	
				Selenium		-	-	110	-	-	92	-	NA	
				Silver		-	-	85	-	-	NA	-	8	
				Zinc		-	-	96	-	-	96	-	0	
Pesticides & PCB's	WATER	DW#2	2274-5	Aldrin		-	-	40	-	-	NA	-	NA	
				Gamma-BHC		-	-	67	-	-	NA	-	NA	ToxScan
				4,4'-DDT		-	-	78	-	-	NA	-	NA	25-May-88
				Dieldrin		-	-	64	-	-	NA	-	NA	
				Endrin		-	-	61	-	-	NA	-	NA	
				Heptachlor		-	-	65	-	-	NA	-	NA	
Pesticides & PCB's	WATER	DW#2	2274-5	Aldrin		-	-	89	-	-	NA	-	NA	ToxScan
				Gamma-BHC		-	-	88	-	-	NA	-	NA	25-May-88
				4,4'-DDT		-	-	112	-	-	NA	-	NA	
				Dieldrin		-	-	98	-	-	NA	-	NA	
				Endrin		-	-	121	-	-	NA	-	NA	
				Heptachlor		-	-	101	-	-	NA	-	NA	

---

* RPD values were calculated by the laboratory.

Table C.3-3 Dry Weather 4

						MATRIX SPIKE			MATRIX SPIKE DUPLICATE					
CHEMICAL GROUP	SAMPLE MATRIX	SAMPLING EVENT	SAMPLE ID No.	ANALYTES	UNITS	MS CONC.	MS REC. CONC.	MS REC. (%)	MSD CONC.	MSD REC. CONC.	MSD REC (%)	LAB REC. LIMITS (%)	RPD* (%)	LAB/ ANALYSIS DATE
Chlorinated Herbicides	WATER	DW#4	08-610-12	2,4,5-T		-	-	-	-	-	127	-	-	B&C
				2,4,5-TP		-	-	-	-	-	127	-	-	23-Aug-88
				2,4-D		-	-	-	-	-	-	-	-	
Polynuclear Aromatic Hydrocarbons (PAH)	WATER	DW#4	S8-08-261-01A	Dibenz(a,h)anthracene	ug/L	50	16	32	-	-	-	-	-	IT
				Anthracene	ug/L	50	38	76	-	-	-	-	-	
				Benzo(a)pyrene	ug/L	50	31	63	-	-	-	-	-	
				Acenaphthene	ug/L	50	30	61	-	-	-	-	-	
Metals	WATER	DW#4	2797	Copper		-	-	101	-	-	-	-	-	ToxScan
				Lead		-	-	135	-	-	-	-	-	20-Oct-88
				Mercury		-	-	82	-	-	-	-	-	
				Selenium		-	-	102	-	-	-	-	-	
				Silver		-	-	108	-	-	-	-	-	
				Zinc		-	-	117	-	-	-	-	-	

---

* RPD values were calculated by the laboratory.

Table C.3-4 Dry Weather 5

						MATRIX SPIKE			MATRIX SPIKE DUPLICATE					
CHEMICAL GROUP	SAMPLE MATRIX	SAMPLING EVENT	SAMPLE ID No.	ANALYTES	UNITS	MS CONC.	MS REC. CONC.	MS REC. (%)	MSD CONC.	MSD REC. CONC.	MSD REC (%)	LAB REC. LIMITS (%)	RPD* (%)	LAB/ ANALYSIS DATE
Polynuclear Aromatic Hydrocarbons (PAH)	WATER	DW#5	44880-0003-MS	Naphthalene	ug/L	5	2.7	54	5	2.94	59	-	-	CAL
				Fluorene	ug/L	1	0.649	65	1	0.682	68	-	-	21-Dec-88
				Pyrene	ug/L	1	0.819	82	1	0.804	80	-	-	
				Benzo(a)pyrene	ug/L	0.5	0.402	80	0.5	0.398	80	-	-	
				Indeno(1,2,3-c,d)pyrene	ug/L	0.5	0.391	78	0.5	0.369	74	-	-	
Polynuclear Aromatic Hydrocarbons (PAH)	WATER	DW#5	44880-0009-MS	Naphthalene	ug/L	1000	ND	* *	-	-	-	-	-	CAL
				Fluorene	ug/L	200	ND	* *	-	-	-	-	-	21-Dec-88
				Pyrene	ug/L	200	252	* *	-	-	-	-	-	
				Benzo(a)pyrene	ug/L	100	149	* *	-	-	-	-	-	
				Indeno(1,2,3-c,d)pyrene	ug/L	100	ND	* *	-	-	-	-	-	
TOC Chlorinated Herbicides	WATER	DW#5	12-322-15	TOC		-	-	114	-	-	-	-	-	B&C
				2,4,5-T		-	-	120	-	-	-	-	-	5-Jan-89
				2,4,5-TP		-	-	94	-	-	-	-	-	
				2,4-D		-	-	110	-	-	-	-	-	
				2,4-DB		-	-	110	-	-	-	-	-	
				Dicamba		-	-	90	-	-	-	-	-	
				Dinoseb		-	-	100	-	-	-	-	-	
Volatile Organics	WATER	DW#5	8811183-09	1,1-dichloroethene	ug/L	50	60	120	50	54	108	81--157	11	Anametrix
				Freon 113	ug/L	50	44	88	50	41	82	91--158	7	5-Dec-88
				Methylene chloride	ug/L	50	57	114	50	55	110	81--141	4	
				Chloroform	ug/L	50	55	110	50	52	104	76--127	6	
				1,1,1-trichloroethane	ug/L	50	60	120	50	56	112	89--147	7	
				Benzene	ug/L	50	63	126	50	60	120	88--137	5	
				1,2-dichloroethane	ug/L	50	61	122	50	59	118	82--121	3	
				Trichloroethene	ug/L	50	46	92	50	43	86	64--131	7	
				4-methyl-2-pentanone	ug/L	50	57	114	50	65	130	58--132	-13	
				Toluene	ug/L	50	58	116	50	56	112	89--125	4	
				Tetrachloroethene	ug/L	50	55	110	50	52	104	85--125	6	
				Chlorobenzene	ug/L	50	55	110	50	53	106	87--124	4	
				1,2-dichlorobenzene	ug/L	50	56	112	50	54	108	93--132	4	
Semivolatile Organics	WATER	DW#5	88111183-10	Phenol	ug/L	100	19	19	-	-	-	10--43		Anametrix
				2-chlorophenol	ug/L	100	32	32	-	-	-	13--84		7-Dec-88
				1,4-dichlorobenzene	ug/L	50	10	20	-	-	-	12--68		
				Nitrosodipropylamine	ug/L	50	19	38	-	-	-	25--96		
				1,2,4-trichlorobenzene	ug/L	50	12	24	-	-	-	17--70		
				4-chloro-3-methylphenol	ug/L	100	74	74	-	-	-	10--127		
				Acenaphthene	ug/L	50	29	58	-	-	-	27--123		
				4-nitrophenol	ug/L	100	34	34	-	-	-	10--66		
				2,4-dinitrotoluene	ug/L	50	35	70	-	-	-	43--117		
				Pentachlorophenol	ug/L	100	83	83	-	-	-	10--151		
				Pyrene	ug/L	50	39	78	-	-	-	47--148		

---

* RPD values were calculated by the laboratory.

Table C.3-5 Dry Weather 6

CHEMICAL GROUP	SAMPLE MATRIX	SAMPLING EVENT	SAMPLE ID No.	ANALYTES	UNITS	MATRIX SPIKE			MATRIX SPIKE DUPLICATE			LAB REC. LIMITS (%)	RPD* (%)	LAB/ ANALYSIS DATE
						MS CONC.	MS REC. CONC.	MS REC. (%)	MSD CONC.	MSD REC. CONC.	MSD REC (%)			
Polynuclear Aromatic	WATER	DW#6	045559-0003MS	Naphthalene	ug/L	5	3.1	62	5	2.1	42	-	38	CAL
Hydrocarbons (PAH)				Fluorene	ug/L	1	0.86	86	1	0.67	67	-	25	14-Feb-89
				Pyrene	ug/L	1	1.1	110	1	0.91	91	-	19	
				Benzo(a)pyrene	ug/L	0.5	0.56	112	0.5	0.47	94	-	17	
				Indeno(1,2,3-c,d)pyrene	ug/L	0.5	0.56	112	0.5	0.48	96	-	15	
Polynuclear Aromatic	WATER	DW#6	045559-0003MS	Naphthalene	ug/L	5	3.08	62	5	2.14	43	-	36	CAL
Hydrocarbons (PAH)				Acenaphthalene	ug/L	5	3.46	69	5	2.66	53	-	26	15-Feb-89
				Acenaphthene	ug/L	10	7.81	78	10	6.49	65	-	18	
				Fluorene	ug/L	1	0.863	86	1	0.673	67	-	25	
				Phenanthrene	ug/L	0.4	0.393	98	0.4	0.323	81	-	20	
				Anthracene	ug/L	0.2	0.196	98	0.2	0.171	86	-	14	
				Fluoranthene	ug/L	0.5	0.539	108	0.5	0.463	93	-	15	
				Pyrene	ug/L	1	1.06	106	1	0.913	91	-	15	
				Benzo(a)anthracene	ug/L	0.5	0.526	105	0.5	0.449	90	-	15	
				Chrysene	ug/L	0.5	0.54	108	0.5	0.466	93	-	15	
				Benzo(b)fluoranthene	ug/L	0.25	0.213	85	0.25	0.185	74	-	14	
				Benzo(k)fluoranthene	ug/L	0.25	0.214	86	0.25	0.183	73	-	16	
				Benzo(a)pyrene	ug/L	0.5	0.56	112	0.5	0.47	94	-	17	
				Dibenzo(a,h)anthracene	ug/L	2	2.12	106	2	1.8	90	-	16	
				Benzo(g,h,i)perylene	ug/L	1	0.937	94	1	0.784	78	-	19	
				Indeno(1,2,3-cd)pyrene	ug/L	0.5	0.565	113	0.5	0.477	95	-	17	

* RPD values were calculated by the laboratory.

Table C.3-6 Wet Weather 1

						MATRIX SPIKE			MATRIX SPIKE DUPLICATE					
CHEMICAL GROUP	SAMPLE MATRIX	SAMPLING EVENT	SAMPLE ID No.	ANALYTES	UNITS	MS CONC.	MS REC. CONC.	MS REC. (%)	MSD CONC.	MSD REC. CONC.	MSD REC (%)	LAB REC. LIMITS (%)	RPD* (%)	LAB/ ANALYSIS DATE
Volatile Organics	WATER	WW#1	553.00 L3	Phenol	ug/L	100	25	25	-	-	-	10--43	-	Anametrix
				2-Chlorophenol	ug/L	100	60	60	-	-	-	13--84	-	5-May-88
				1,4-Dichlorobenzene	ug/L	50	28	56	-	-	-	12--68	-	
				Nitrosodipropiamine	ug/L	50	35	70	-	-	-	25--96	-	
				1,2,4-Trichlorobenzene	ug/L	50	30	60	-	-	-	17--70	-	
				4-Chloro-3-methylphenol	ug/L	100	85	85	-	-	-	10--127	-	
				Acenaphtene	ug/L	50	39	78	-	-	-	27--123	-	
				4-Nitrophenol	ug/L	100	32	32	-	-	-	10--66	-	
				2,4-Dinitrotoluene	ug/L	50	41	82	-	-	-	43--117	-	
				Pentachlorophenol	ug/L	100	100	100	-	-	-	10--151	-	
				Pyrene	ug/L	50	43	86	-	-	-	47--148	-	
METALS	WATER	WW#1	2330	Arsenic		-	-	120	-	-	120	-	0	ToxScan
				Cadmium		-	-	117	-	-	70	-	0	27-May-88
				Chromium		-	-	66	-	-	102	-	25	
				Copper		-	-	114	-	-	98	-	3.2	
				Lead		-	-	134	-	-	109	-	0	
				Mercury		-	-	104	-	-	100	-	0	
				Nickel		-	-	103	-	-	106	-	4.3	
				Selenium		-	-	116	-	-	97	-		
				Silver		-	-	80	-	-	NA	-	18.2	
				Zinc		-	-	85	-	-	109	-	0	

---

* RPD values were calculated by the laboratory.

Table C.3-7 Wet Weather 2

						MATRIX SPIKE			MATRIX SPIKE DUPLICATE					
CHEMICAL GROUP	SAMPLE MATRIX	SAMPLING EVENT	SAMPLE ID No.	ANALYTES	UNITS	MS CONC.	MS REC. CONC.	MS REC. (%)	MSD CONC.	MSD REC. CONC.	MSD REC (%)	LAB REC. LIMITS (%)	RPD* (%)	LAB/ ANALYSIS DATE
METALS	WATER	WW#2	3264	Arsenic		-	-	72	-	-	70	-	NA	ToxScan 29-Nov-88
				Cadmium		-	-	102	-	-	92	-	9	
				Chromium		-	-	127	-	-	121	-	2	
				Copper		-	-	126	-	-	130	-	3	
				Lead		-	-	250	-	-	125	-	13	
				Mercury		-	-	96	-	-	80	-	25	
				Selenium		-	-	149	-	-	131	-	18	
				Silver		-	-	67	-	-	72	-	NA	
				Zinc		-	-	78	-	-	NA	-	0	
TOC	WATER	WW#2	11-635-13	TOC		-	-	80	-	-	-	-	-	B&C 24-Nov-88
Chlorinated Herbicides	WATER	WW#2	11-635-15	2,4,5-T		-	-	140	-	-	26	-	-	B&C 24-Nov-88
				2,4,5-TP Silvex		-	-	110	-	-	18	-	-	
				2,4-D		-	-	130	-	-	22	-	-	
				2,4-DB		-	-	190	-	-	68	-	-	
				Dicamba		-	-	100	-	-	32	-	-	
				Dinoseb		-	-	71	-	-	12	-	-	

* RPD values were calculated by the laboratory.

Table C.3-8 Wet Weather 3

						MATRIX SPIKE			MATRIX SPIKE DUPLICATE					
CHEMICAL GROUP	SAMPLE MATRIX	SAMPLING EVENT	SAMPLE ID No.	ANALYTES	UNITS	MS CONC.	MS REC. CONC.	MS REC. (%)	MSD CONC.	MSD REC. CONC.	MSD REC (%)	LAB REC. LIMITS (%)	RPD* (%)	LAB/ ANALYSIS DATE
Polynuclear Aromatic Hydrocarbons (PAH)	WATER	WW#3	45459-0004	Naphthalene	ug/L	5	1.4	28	5	1.5	30	-	7	CAL
				Fluorene	ug/L	1	0.75	75	1	0.78	78	-	4	4-Feb-89
				Pyrene	ug/L	1	1.3	97	1	1.4	107	-	10	
				Benzo(a)pyrene	ug/L	0.5	0.65	130	0.5	0.65	130	-	0	
				Indeno(1,2,3-c,d)pyrene	ug/L	0.5	0.65	130	0.5	0.64	128	-	2	
Polynuclear Aromatic Hydrocarbons (PAH)	WATER	WW#3	045459-4MS/MSD	Naphthalene	ug/L	5	1.37	27	5	1.53	31	-	14	CAL
				Acenaphthalene	ug/L	5	3.5	70	5	3.46	69	-	1	4-Feb-89
				Acenaphthene	ug/L	10	7.64	76	10	6.76	68	-	1	
				Fluorene	ug/L	1	0.752	75	1	0.779	78	-	4	
				Phenanthrene	ug/L	0.4	0.582	146	0.4	0.572	143	-	2	
				Anthracene	ug/L	0.2	0.158	79	0.2	0.173	87	-	10	
				Fluoranthene	ug/L	0.5	0.931	129	0.5	0.885	119	-	8	
				Pyrene	ug/L	1	1.34	101	1	1.38	105	-	4	
				Benzo(a)anthracene	ug/L	0.5	0.493	99	0.5	0.513	103	-	4	
				Chrysene	ug/L	0.5	0.588	118	0.5	0.609	122	-	3	
				Benzo(b)fluoranthene	ug/L	0.25	0.395	158	0.25	0.398	159	-	0.6	
				Benzo(k)fluoranthene	ug/L	0.25	0.256	102	0.25	0.26	104	-	2	
				Benzo(a)pyrene	ug/L	0.5	0.65	130	0.5	0.648	130	-	0	
				Dibenzo(a,h)anthracene	ug/L	2	1.62	81	2	1.58	79	-	3	
				Benzo(g,h,i)perylene	ug/L	1	0.761	76	1	0.823	82	-	7	
				Indeno(1,2,3-cd)pyrene	ug/L	0.5	0.648	130	0.5	0.644	129	-	1	

---

* RPD values were calculated by the laboratory.

Table C.3-9 Wet Weather 4

CHEMICAL GROUP	SAMPLE MATRIX	SAMPLING EVENT	SAMPLE ID No.	ANALYTES	UNITS	MATRIX SPIKE			MATRIX SPIKE DUPLICATE			LAB REC. LIMITS (%)	RPD* (%)	LAB/ ANALYSIS DATE
						MS CONC.	MS REC. CONC.	MS REC. (%)	MSD CONC.	MSD REC. CONC.	MSD REC (%)			
Polynuclear Aromatic Hydrocarbons (PAH)	WATER	WW#4	045596-0005MS	Naphthalene	ug/L	5	ND	NC	-	-	-	-	-	CAL
				Fluorene	ug/L	1	0.58	58	-	-	-	-	-	17-Feb-89
				Pyrene	ug/L	1	1.2	120	-	-	-	-	-	
				Benzo(a)pyrene	ug/L	0.5	0.5	100	-	-	-	-	-	
				Indeno(1,2,3-c,d)pyrene	ug/L	0.5	0.66	132	-	-	-	-	-	
TOC	WATER	WW#4	02-154-14	TOC		-	-	118	-	-	-	-	-	B&C
TOX				TOX		-	-	107	-	-	-	-	-	

* RPD values were calculated by the laboratory.

Table C.3-10 Wet Weather 5

						MATRIX SPIKE			MATRIX SPIKE DUPLICATE					
CHEMICAL GROUP	SAMPLE MATRIX	SAMPLING EVENT	SAMPLE ID No.	ANALYTES	UNITS	MS CONC.	MS REC. CONC.	MS REC. (%)	MSD CONC.	MSD REC. CONC.	MSD REC (%)	LAB REC. LIMITS (%)	RPD* (%)	LAB/ ANALYSIS DATE
TOC	WATER	WW#5	02-388-015	TOC		-	-	120	-	-	-	-	-	B&C
TOX				TOX		-	-	105	-	-	-	-	-	
Polynuclear Aromatic Hydrocarbons (PAH)	WATER	WW#5	045559-0003MS	Naphthalene	ug/L	5	ND	NC	-	-	-	-	-	CAL 22-Feb-89
				Fluorene	ug/L	1	0.53	53	-	-	-	-	-	
				Pyrene	ug/L	1	2.9	90	-	-	-	-	-	
				Benzo(a)pyrene	ug/L	0.5	1.2	58	-	-	-	-	-	
				Indeno(1,2,3-c,d)pyrene	ug/L	0.5	1.5	NC	-	-	-	-	-	
									SAMPLE					
Polynuclear Aromatic Hydrocarbons (PAH)	WATER	WW#5	045688-0001	Naphthalene	ug/L	-	-	-	ND	ND	-	-	NC	CAL 15-Feb-89
				Acenaphthalene	ug/L	-	-	-	ND	ND	-	-	NC	
				Acenaphthene	ug/L	-	-	-	ND	ND	-	-	NC	
				Fluorene	ug/L	-	-	-	ND	ND	-	-	NC	
				Phenanthrene	ug/L	-	-	-	ND	ND	-	-	NC	
				Anthracene	ug/L	-	-	-	ND	ND	-	-	NC	
				Fluoranthene	ug/L	-	-	-	2.4	2.6	-	-	8	
				Pyrene	ug/L	-	-	-	2	2.2	-	-	9.5	
				Benzo(a)anthracene	ug/L	-	-	-	0.56	0.6	-	-	6.9	
				Chrysene	ug/L	-	-	-	ND	ND	-	-	NC	
				Benzo(b)fluoranthene	ug/L	-	-	-	0.78	0.86	-	-	9.8	
				Benzo(k)fluoranthene	ug/L	-	-	-	0.34	0.37	-	-	8.5	
				Benzo(a)pyrene	ug/L	-	-	-	0.91	1	-	-	9.4	
				Dibenzo(a,h)anthracene	ug/L	-	-	-	ND	ND	-	-	NC	
				Benzo(g,h,i)perylene	ug/L	-	-	-	1.3	1.5	-	-	14	
				Indeno(1,2,3-cd)pyrene	ug/L	-	-	-	1.4	1.2	-	-	15	

---

* RPD values were calculated by the laboratory.

Table C.3-11 Sediment 1

						MATRIX SPIKE			MATRIX SPIKE DUPLICATE					
CHEMICAL GROUP	SAMPLE MATRIX	SAMPLING EVENT	SAMPLE ID No.	ANALYTES	UNITS	MS CONC.	MS REC. CONC.	MS REC. (%)	MSD CONC.	MSD REC. CONC.	MSD REC (%)	LAB REC. LIMITS (%)	RPD* (%)	LAB/ ANALYSIS DATE
Volatile Organics	SOIL	Sed#1	553.04 S-3	Phenol	mg/kg	3300	2300	70	3300	2500	76	18--85	8	Anametrix
				2-Chlorophenol	mg/kg	3300	2200	67	3300	2300	80	15--79	4	13-Apr-88
				1,4-Dichlorobenzene	mg/kg	1700	1000	59	1700	1100	65	10--76	10	
				Nitrosodipropiamine	mg/kg	1700	1200	71	1700	1200	76	16--83	8	
				1,2,4-Trichlorobenzene	mg/kg	1700	1100	65	1700	1200	71	12--78	9	
				4-Chloro-3-methylphenol	mg/kg	3300	2900	88	3300	3100	94	39--96	7	
				Acenaphtene	mg/kg	1700	1400	82	1700	1500	88	10--116	7	
				4-Nitrophenol	mg/kg	3300	2000	61	3300	2000	61	29--116	0	
				2,4-Dinitrotoluene	mg/kg	1700	1400	82	1700	1500	88	27--104	7	
				Pentachlorophenol	mg/kg	3300	2300	70	3300	2400	73	18--125	4	
				Pyrene	mg/kg	1700	1500	88	1700	1700	100	33--129	13	

---

* RPD values were calculated by the laboratory.

Table C.3-12 Sediment 2

CHEMICAL GROUP	SAMPLE MATRIX	SAMPLING EVENT	SAMPLE ID No.	ANALYTES	UNITS	MATRIX SPIKE MS CONC.	MATRIX SPIKE MS REC. CONC.	MATRIX SPIKE MS REC. (%)	MATRIX SPIKE DUPLICATE MSD CONC.	MATRIX SPIKE DUPLICATE MSD REC. CONC.	MATRIX SPIKE DUPLICATE MSD REC (%)	LAB REC. LIMITS (%)	RPD* (%)	LAB/ ANALYSIS DATE
Pesticides & PCB's	SOIL	Sed#2	2376	Lindane		-	-	82	-	-	90	-	4.6	ToxScan
				Heptchlor		-	-	104	-	-	110	-	2.8	8-Jun-88
				Aldrin		-	-	60	-	-	60	-	0	
				Dieldrin		-	-	88	-	-	96	-	4.1	
				Endrin		-	-	108	-	-	112	-	1.8	
				4,4'-DDT		-	-	159	-	-	138	-	14	

* RPD values were calculated by the laboratory.

Table C.3-13 Sediment 3

						MATRIX SPIKE			MATRIX SPIKE DUPLICATE					
CHEMICAL GROUP	SAMPLE MATRIX	SAMPLING EVENT	SAMPLE ID No.	ANALYTES	UNITS	MS CONC.	MS REC. CONC.	MS REC. (%)	MSD CONC.	MSD REC. CONC.	MSD REC (%)	LAB REC. LIMITS (%)	RPD* (%)	LAB/ ANALYSIS DATE
Organophosphorus Pesticides	SOIL	Sed#3	S8-08-261-02B	Ethoprop	mg/kg	-	-	0.99	-	0.8	81	-	-	ToxScan
				Ethion	mg/kg	-	-	0.99	-	0.87	88	-	-	6-Oct-88
Chlorinated Herbicides	SOIL	Sed#3	08-610-14	2,4,5-T		-	-	-	-	-	86	-	-	B&C
				2,4,5-TP		-	-	-	-	-	75	-	-	23-Aug-88
				2,4-D		-	-	-	-	-	56	-	-	

---

* RPD values were calculated by the laboratory.

Table C.3-14 Sediment 4

						MATRIX SPIKE			MATRIX SPIKE DUPLICATE					
CHEMICAL GROUP	SAMPLE MATRIX	SAMPLING EVENT	SAMPLE ID No.	ANALYTES	UNITS	MS CONC.	MS REC. CONC.	MS REC. (%)	MSD CONC.	MSD REC. CONC.	MSD REC (%)	LAB REC. LIMITS (%)	RPD* (%)	LAB/ ANALYSIS DATE
Chlorinated Herbicides	SOIL	Sed#4	12-322-17	2,4,5-T		-	-	120	-	-	92	-	-	B&C
				2,4,5-TP		-	-	93	-	-	65	-	-	24-Dec-88
				2,4-D		-	-	100	-	-	76	-	-	
				2,4-DB		-	-	120	-	-	88	-	-	
				Dicamba		-	-	98	-	-	54	-	-	

* RPD values were calculated by the laboratory.

APPENDIX C.4

RESULTS OF METHOD, FIELD, AND TRIP BLANKS

MB	Method Blank
TB	Trip Blank
FB	Field Blank
EB	Equipment Blank - collected only during the wet weather sampling rounds; see QA/QC discussion on blank contamination for details

Table C.4-1 Dry Weather 1

CHEMICAL GROUP	ANALYSIS METHOD	SAMPLING EVENT	SAMPLE/ ID No.	ANALYTES	CONC.	UNITS	SAMPLING DATE	REMARKS
Volatile Organics	EPA 624	DW#1	MB	Methylene Chloride	6	ug/L	8-Mar-88	
Semivolatile Organics	EPA 625	DW#1	MB	BEHP*	18	ug/L	8-Mar-88	

* bis(2-ethylhexyl)phthalate

Table C.4-2 Dry Weather 2

CHEMICAL GROUP	ANALYSIS METHOD	SAMPLING EVENT	SAMPLE/ ID No.	ANALYTES	CONC.	UNITS	SAMPLING DATE	REMARKS
Volatile Organics	EPA 624	DW#2	MB	Acetone	27	ug/L	8-Apr-88	
				Methylene Chloride	11	ug/L		
Semivolatile Organics	EPA 625	DW#2	MB	BEHP*	800	ug/L	9-Apr-88	
Semivolatile Organics	EPA 625	DW#2	MB	BEHP*	410	ug/L	10-Apr-88	

* bis(2-ethylhexyl)phthalate

Table C.4-3. Dry Weather 4

CHEMICAL GROUP	ANALYSIS METHOD	SAMPLING EVENT	SAMPLE/ ID No.	ANALYTES	CONC.	UNITS	SAMPLING DATE
Chlor. Herbicides	SW8150	DW#4	FB	Chlor. Herbicides	ND	ug/l	23-Aug-88
TOX	9020	DW#4	FB	TOX	ND	mg/L	23-Aug-88
Chlor. Herbicides	SW8150	DW#4	TB	Chlor. Herbicides	ND	ug/L	23-Aug-88
TOX	9020	DW#4	TB	TOX	ND	mg/L	23-Aug-88
Total Coliform	909C	DW#4	FB	Total Coliform	ND	MPN/100 ml	1-Sep-88
Fecal Coliform	909A	DW#4	FB	Fecal Coliform	ND	MPN/100 ml	1-Sep-88
Metals	SW6010	DW#4	FB/ T88-2797	Mercury Zinc	0.0003 0.011	mg/L mg/L	26-Aug-88
Metals	SW6010	DW#4	MB	Metals	ND		26-Aug-88
Nitrite	354.1	DW#4	FB/ T88-2797	Nitrite	ND	mg/L	26-Aug-88
Nitrate	353.2	DW#4	FB/ T88-2797	Nitrate	ND	mg/L	26-Aug-88
TKN	351.2	DW#4	FB/ T88-2797	TKN	ND	mg/L	26-Aug-88
TSS	160.3	DW#4	FB/ T88-2797	TSS	2.5	mg/L	26-Aug-88
BOD	405.1	DW#4	FB/ T88-2797	BOD	8	mg/L	26-Aug-88
Polynuclear Aromati Hydrocarbons (PAH)	EPA 610	DW#4	FB/ S8-08-261 -04A	PAH Compounds	ND	ug/L	26-Aug-88

Table C.4-4. Dry Weather 5

CHEMICAL GROUP	ANALYSIS METHOD	SAMPLING EVENT	SAMPLE/ ID No.	ANALYTES	CONC.	UNITS	SAMPLING DATE
Polynuclear Aromatic Hydrocarbons (PAH)	EPA 610	DW#5	MB	PAH	ND	ug/L	-
Polynuclear Aromatic Hydrocarbons (PAH)	EPA 610	DW#5	FB	PAH	ND	ug/L	13-Dec-88
TOX	9020	DW#5	FB/ 12-322-5	TOX	0.03	mg/L	13-Dec-88
TOX	9020	DW#5	MB/ 12-322-12	TOX	ND	mg/L	13-Dec-88
Chlor. Herbicides	SW8150	DW#5	FB/ 12-322-5	Chlor. Herbicides	ND	ug/L	13-Dec-88
Chlor. Herbicides	SW8150	DW#5	MB/ 12-322-19	Chlor. Herbicides	ND	ug/L	13-Dec-88
Total Coliform	909C	DW#5	FB	Total Coliform	ND	MPN/100 ml	24-Dec-88
Fecal Coliform	909A	DW#5	FB	Fecal Coliform	ND	MPN/100 ml	24-Dec-88
Pesticides & PCBs	E608	DW#5	FB/ T88-3340	Pest. & PCBs	ND	ug/L	24-Dec-88
Metals	SW6010	DW#5	FB/ T88-3340	Zinc	0.014	mg/L	24-Dec-88
Metals	SW6010	DW#5	MB	Metals	ND	mg/L	24-Dec-88
TKN	351.2	DW#5	FB/ T88-3340	TKN	ND	mg/L	24-Dec-88
TSS	160.3	DW#5	FB/ T88-3340	TSS	ND	mg/L	24-Dec-88
BOD	405.1	DW#5	FB/ T88-3340	BOD	ND	mg/L	24-Dec-88
Hardness	200.7	DW#5	FB/ T88-3340	Hardness	ND	mg/L	24-Dec-88
Turbidity	180.1	DW#5	FB/ T88-3340	Turbidity	ND	NTU	24-Dec-88
Polynuclear Aromatic Hydrocarbons (PAH)	EPA 610	DW#5	MB/ 44880-MB	PAH Compounds	ND	ug/L	24-Dec-88

Table C.4-5. Dry Weather 6

CHEMICAL GROUP	ANALYSIS METHOD	SAMPLING EVENT	SAMPLE/ ID No.	ANALYTES	CONC.	UNITS	SAMPLING DATE
Total Coliform	909C	DW#6	FB	Total Coliform	ND	MPN/100 ml	14-Feb-89
Fecal Coliform	909A	DW#6	FB	Fecal Coliform	ND	MPN/100 ml	14-Feb-89
Peaticides & PCBs	E608	DW#6	FB/ T-3531	Pesticides & PCBs	ND	ug/L	14-Feb-89
Metals	SW6010	DW#6	FB/ T-3531	Lead Zinc	0.003 0.010	mg/L	14-Feb-89
Metals	SW6010	DW#6	MB	Metals	ND	mg/L	14-Feb-89
TKN	351.2	DW#6	FB/ T-3531	TKN	ND	mg/L	14-Feb-89
TSS	160.3	DW#6	FB/ T-3531	TSS	ND	mg/L	14-Feb-89
BOD	405.1	DW#6	FB/ T-3531	BOD	ND	mg/L	14-Feb-89
Hardness	200.7	DW#6	FB/ T-3531	Hardness	ND	mg/L	14-Feb-89
Turbidity	180.1	DW#6	FB/ T-3531	Turbidity	ND	NTU	14-Feb-89
Polynuclear Aromatic Hydrocarbons (PAH)	EPA 610	DW#6	MB/ 45559-0006SA	PAH Compounds	ND	ug/L	14-Feb-89
Polynuclear Aromatic Hydrocarbons (PAH)	EPA 610	DW#6	MB/ 45559-0006SA	PAH Compounds	ND	ug/L	14-Feb-89

Table C.4-6. Dry Weather 7

CHEMICAL GROUP	ANALYSIS METHOD	SAMPLING EVENT	SAMPLE/ ID No.	ANALYTES	CONC.	UNITS	SAMPLING DATE
Total Coliform	909C	DW#7	FB	Total Coliform	ND	MPN/100 ml	19-Apr-89
Fecal Coliform	909A	DW#7	FB	Fecal Coliform	ND	MPN/100 ml	19-Apr-89
TOC	415.1	DW#7	FB/ 04-195-8	TOC	ND	mg/L	19-Apr-89
Peaticides & PCBs	E608	DW#7	FB/ T-3839	Pest. & PCBs	ND	ug/L	19-Apr-89
Metals	SW6010	DW#7	FB/ T-3839	Zinc	0.006	mg/L mg/L	19-Apr-89
Metals	SW6010	DW#7	MB	Metals	ND	mg/L	19-Apr-89
TKN	351.2	DW#7	FB/ T-3839	TKN	ND	mg/L	19-Apr-89
TSS	160.3	DW#7	FB/ T-3839	TSS	ND	mg/L	19-Apr-89
BOD	405.1	DW#7	FB/ T-3839	BOD	ND	mg/L	19-Apr-89
Hardness	200.7	DW#7	FB/ T-3839	Hardness	ND	mg/L	19-Apr-89
Turbidity	180.1	DW#7	FB/ T-3839	Turbidity	ND	NTU	19-Apr-89
Polynuclear Aromatic Hydrocarbons (PAH)	EPA 610	DW#7	FB/ 45559-0006SA	PAH Compounds	ND	ug/L	19-Apr-89
Polynuclear Aromatic Hydrocarbons (PAH)	EPA 610	DW#7	MB	PAH Compounds	ND	ug/L	19-Apr-89
Polynuclear Aromatic Hydrocarbons (PAH)	EPA 610	DW#7	FB/ 45559-0006SA	PAH Compounds	ND	ug/L	19-Apr-89

Table C.4-7 Wet Weather 1

CHEMICAL GROUP	ANALYSIS METHOD	SAMPLING EVENT	SAMPLE/ ID No.	ANALYTES	CONC.	UNITS	SAMPLING DATE	REMARKS
Volatile Organics	EPA 624	WW#1	MB	Acetone	20	ug/L	23-Apr-89	
				Methylene Chloride	7	ug/L		
Volatile Organics	EPA 624	WW#1	MB	Methylene Chloride	9	ug/L	26-Apr-89	
				1,1,1-trichloroethane	9	ug/L		
Semivolatile Organics	EPA 625	WW#1	MB	BEHP*	11	ug/L	4-May-89	

* bis(2-ethylhexyl)phthalate

Table C.4-8. Wet Weather 2

CHEMICAL GROUP	ANALYSIS METHOD	SAMPLING EVENT	SAMPLE/ ID No.	ANALYTES	CONC.	UNITS	SAMPLING DATE
TOC	415.1	WW#2	MB 11-635-17	TOC	0.7	mg/L	24-Nov-88
TOX	9020	WW#2	MB 11-635-17	TOX	ND	mg/L	24-Nov-88
Chlorinated Herbicides	SW8150	WW#2	MB 11-635-17	Chlorinated Herb	ND	ug/L	24-Nov-88
Volatile Organics	EPA 624	WW#2	MB	Volatile Organics	ND	ug/L	2-Dec-88
Volatile Organics	EPA 624	WW#2	MB	Volatile Organics	ND	ug/L	3-Dec-88
Volatile Organics	EPA 624	WW#2	MB	Volatile Organics	ND	ug/L	5-Dec-88
Semivolatile Organics	EPA 625	WW#2	MB	BEHP	120	ug/L	6-Dec-88
Semivolatile Organics	EPA 625	WW#2	MB	BEHP	50	ug/L	7-Dec-88
Metals	SW6010	WW#2	EB/ T88-3264	Cadmium Chromium,Total Mercury Silver	0.0002 0.002 0.0004 0.0002	mg/L mg/L mg/L mg/L	29-Nov-88
Metals	SW6010	WW#2	MB	Cadmium Chromium,Total Mercury Silver	0.0002 ND ND ND	mg/L mg/L mg/L mg/L	29-Nov-88
TKN	351.2	WW#2	EB/ T88-3264	TKN	ND	mg/L	29-Nov-88
Ammonia (as N)	350.1	WW#2	EB/ T88-3264	Ammonia (as N)	ND	mg/L	
Nitrate (as N)	353.2	WW#2	EB/ T88-3264	Nitrate (as N)	ND	mg/L	
Nitrite (as N)	354.1	WW#2	EB/ T88-3264	Nitrite (as N)	ND	mg/L	
Hardness	200.7	WW#2	EB/ T88-3264	Hardness	ND	mg/L	

Table C.4-9. Wet Weather 2 (Continued)

CHEMICAL GROUP	ANALYSIS METHOD	SAMPLING EVENT	SAMPLE/ ID No.	ANALYTES	CONC.	UNITS	SAMPLING DATE
TOX	9020	WW#2	EB/ 11-635-12	TOX	ND	mg/L	24-Nov-88
TOX	9020	WW#2	MB/ 11-635-17	TOX	ND	mg/L	24-Nov-88
TOC	415.1	WW#2	MB/ 11-635-17	TOC	0.7	mg/L	24-Nov-88
Chlor. Herbicides	SW8150	WW#2	EB/ 11-635-12	Chlor. Herbicides	ND	ug/L	24-Nov-88
Chlor. Herbicides	SW8150	WW#2	MB/ 11-635-12	Chlor. Herbicides	ND	ug/L	24-Nov-88
Volatile Organics	EPA 624	WW#2	EB 8811183-12	Volatile Organics	ND	ug/L	3-Dec-88
Semivolatile Organics	EPA 625	WW#2	EB 8811183-12	Semivolatile Organics	ND	ug/L	8-Dec-88
Pesticides & PCB's	EPA 608	WW#2	EB	Pesticides & PCB	ND	ug/L	24-Nov-88
Total Coliform	909C	WW#2	EB	Total Coliform	ND	MPN/100 ml	24-Nov-88
Fecal Coliform	909A	WW#2	EB	Fecal Coliform	ND	MPN/100 ml	24-Nov-88

Table C.4-10 Wet Weather 3

CHEMICAL GROUP	ANALYSIS METHOD	SAMPLING EVENT	SAMPLE/ ID No.	ANALYTES	CONC.	UNITS	SAMPLING DATE
Polynuclear Aromatic Hydrocarbons (PAH)	EPA 610	WW#3	MB	PAH Compounds	ND		2-Feb-89
Polynuclear Aromatic Hydrocarbons (PAH)	EPA 610	WW#3	EB	PAH Compounds	ND		4-Feb-89
TOX	9020	WW#3	EB 01-539-8	TOX	ND	mg/L	24-Jan-88
Metals	SW6010	WW#3	EB T-3497	Cadmium Zinc	0.0019 0.01	mg/L	14-Apr-88
Metals	SW6010	WW#3	MB	Metals	ND	mg/L	14-Apr-88
TKN	351.2	WW#3	EB T-3497	TKN	ND	mg/L	14-Apr-88
TSS	160.3	WW#3	EB T-3497	TSS	ND	mg/L	14-Apr-88
BOD	405.1	WW#3	EB T-3497	BOD	ND	mg/L	14-Apr-88
Hardness	200.7	WW#3	EB T-3497	Hardness	ND	mg/L	14-Apr-88
Turbidity	180.1	WW#3	EB T-3497	Turbidity	ND	NTU	14-Apr-88
Polynuclear Aromatic Hydrocarbons (PAH)	EPA 610	WW#3	EB 45559-0006SA	PAH Compounds	ND	ug/L	2-Feb-88
Polynuclear Aromatic Hydrocarbons (PAH)	EPA 610	WW#3	MB 45559-MB	PAH Compounds	ND	ug/L	2-Feb-88
Total Coliform	909C	WW#3	EB	Total Coliform	ND	MPN/100 ml	2-Feb-88
Fecal Coliform	909A	WW#3	EB	Fecal Coliform	ND	MPN/100 ml	2-Feb-88
Fecal Strep		WW#3	EB	Fecal Strep	ND	MPN/100 ml	2-Feb-88
Pesticides & PCB's	EPA 608	WW#3	EB T-3497	4,4'-DDE	0.077	ug/L	14-Apr-88

Table C.4-11 Wet Weather 4

CHEMICAL GROUP	ANALYSIS METHOD	SAMPLING EVENT	SAMPLE/ ID No.	ANALYTES	CONC.	UNITS	SAMPLING DATE
TOX	9020	WW#4	EB 02-154-12	TOX	ND	mg/L	5-Feb-89
Metals	SW6010	WW#4	EB T-3553	Metals	ND	mg/L	18-Apr-89
Metals	SW6010	WW#4	MB	Metals	ND	mg/L	18-Apr-89
TKN	351.2	WW#4	EB T-3553	TKN	ND	mg/L	18-Apr-89
TSS	160.3	WW#4	EB T-3553	TSS	ND	mg/L	18-Apr-89
BOD	405.1	WW#4	EB T-3553	BOD	ND	mg/L	18-Apr-89
Hardness	200.7	WW#4	EB T-3553	Hardness	ND	mg/L	18-Apr-89
Turbidity	180.1	WW#4	EB T-3553	Turbidity	ND	NTU	18-Apr-89
Polynuclear Aromatic Hydrocarbons (PAH)	EPA 610	WW#4	EB 45556-0012	PAH Compounds	ND	ug/L	17-Feb-89
Polynuclear Aromatic Hydrocarbons (PAH)	EPA 610	WW#4	MB 45556-MB	PAH Compounds	ND	ug/L	17-Feb-89
Pesticides & PCB's	EPA 608	WW#4	EB T-3553	Pesticides & PCB	ND	ug/L	18-Apr-89

Table C.4-12 Wet Weather 5

CHEMICAL GROUP	ANALYSIS METHOD	SAMPLING EVENT	SAMPLE/ ID No.	ANALYTES	CONC.	UNITS	SAMPLING DATE
TOX	9020	WW#5	EB 02-358-13	TOX	ND	mg/L	10-Feb-89
Metals	SW6010	WW#5	EB T-3572	Copper	0.004	mg/L	10-Feb-89
Metals	SW6010	WW#5	MB	Metals	ND	mg/L	10-Feb-89
TKN	351.2	WW#5	EB T-3572	TKN	ND	mg/L	10-Feb-89
TSS	160.3	WW#5	EB T-3572	TSS	ND	mg/L	10-Feb-89
BOD	405.1	WW#5	EB T-3572	BOD	ND	mg/L	10-Feb-89
Hardness	200.7	WW#5	EB T-3572	Hardness	ND	mg/L	10-Feb-89
Turbidity	180.1	WW#5	EB T-3572	Turbidity	ND	NTU	10-Feb-89
Polynuclear Aromatic Hydrocarbons (PAH)	EPA 610	WW#5	EB 45688-0013	PAH Compounds	ND	ug/L	22-Feb-89
Polynuclear Aromatic Hydrocarbons (PAH)	EPA 610	WW#5	MB 45688-MB	PAH Compounds	ND	ug/L	22-Feb-89
Pesticides & PCB's	EPA 608	WW#5	EB T-3572	Pesticides & PCB	ND	ug/L	10-Feb-89
Total Coliform	909C	WW#5	EB	Total Coliform	ND	MPN/100 ml	10-Feb-89
Fecal Coliform	909A	WW#5	EB	Fecal Coliform	ND	MPN/100 ml	10-Feb-89

Table C.4-13 Wet Weather 6

CHEMICAL GROUP	ANALYSIS METHOD	SAMPLING EVENT	SAMPLE/ ID No.	ANALYTES	CONC.	UNITS	SAMPLING DATE
Pesticides & PCB's	EPA 608	WW#6	EB T-3659	Pesticides & PCB	ND	ug/L	3-Mar-89
Total Coliform	909C	WW#6	EB	Total Coliform	ND	MPN/100 ml	3-Mar-89
Fecal Coliform	909A	WW#6	EB	Fecal Coliform	ND	MPN/100 ml	3-Mar-89
Metals* (Total)	SW6010	WW#6	EB T-3659	Chromium	0.052	mg/L	3-Mar-89
				Copper	0.011		
				Lead	0.001		
				Nickel	0.06		
				Zinc	0.018		
Metals* (Dissolved)	SW6010	WW#6	EB T-3659	Chromium	0.001	mg/L	3-Mar-89
				Copper	0.006		
				Nickel	0.004		
				Zinc	0.015		
Metals (Total)	SW6010	WW#6	MB	Chromium	0.002	mg/L	3-Mar-89
				Chromium	0.001		
TKN	351.2	WW#6	EB T-3659	TKN	ND	mg/L	3-Mar-89
Polynuclear Aromatic Hydrocarbons (PAH)	EPA 610	WW#6	EB 46005-0009	PAH Compounds	ND	ug/L	10-Mar-89
Polynuclear Aromatic Hydrocarbons (PAH)	EPA 610	WW#6	MB 46005-MB	PAH Compounds	ND	ug/L	10-Mar-89
TOX	9020	WW#6	EB 03-115-11	TOX	ND	mg/L	3-Mar-89

* Blank water was taken directly from the solar still; see QA/QC discussion on blank contamination

Table C.4-14 Wet Weather 7

CHEMICAL GROUP	ANALYSIS METHOD	SAMPLING EVENT	SAMPLE/ ID No.	ANALYTES	CONC.	UNITS	SAMPLING DATE
Metals	SW6010	WW#7	EB T-3769	Arsenic Chromium Zinc	0.001 0.001 0.003	mg/L	29-Mar-89
Metals	SW6010	WW#7	MB	Metals	ND	mg/L	29-Mar-89

Table C.4-15 Sediment 2

CHEMICAL GROUP	ANALYSIS METHOD	SAMPLING EVENT	SAMPLE/ ID No.	ANALYTES	CONC.	UNITS	SAMPLING DATE
Volatile Organics	EPA 624	Sed#2	MB	Volatile Organics	ND	ug/kg	3-Jun-88
Semivolatile Organics	EPA 625	Sed#2	MB	BEHP*	940	ug/kg	3-Jun-88

* bis(2-ethylhexyl)phthalate

Table C.4-16 Sediment 3

CHEMICAL GROUP	ANALYSIS METHOD	SAMPLING EVENT	SAMPLE/ ID No.	ANALYTES	CONC.	UNITS	SAMPLING DATE
Semivolatile Organics	EPA 625	Sed#3	MB	BEHP*	2400	ug/kg	13-Sep-88
Semivolatile Organics	EPA 625	Sed#3	MB	BEHP*	1400	ug/kg	13-Sep-88

* bis(2-ethylhexyl)phthalate

Table C.4-17 Sediment 4

CHEMICAL GROUP	ANALYSIS METHOD	SAMPLING EVENT	SAMPLE/ ID No.	ANALYTES	CONC.	UNITS	SAMPLING DATE
Polynuclear Aromatic Hydrocarbons (PAH)	EPA 610	Sed#4	MB1	PAH Compounds	ND	ug/kg	-
Polynuclear Aromatic Hydrocarbons (PAH)	EPA 610	Sed#4	MB2	PAH Compounds	ND	ug/kg	-
Chlorinated Herbicides	SW8150	Sed#4	MB 12-322-12	Chlorinated Herb	ND	mg/kg	13-Dec-88

APPENDIX C.5

RESULTS OF ERA QUALITY CONTROL SAMPLES

Table C.5.1. SUMMARY OF RELATIVE PERCENT DIFFERENCES (RPD) BETWEEN ACTUAL AND ERA CERTIFIED CONCENTRATIONS

CONSTITUENT	1st Quarter '88			2nd Quarter '88			3rd Quarter '88			4th Quarter '88			1st Quarter '89			
	ACTUAL CONC. (µg/L)	ERA * CERT. VALUE (µg/L)	RPD (%)	ACTUAL CONC. (µg/L)	ERA CERT. VALUE (µg/L)	RPD (%)	ACTUAL CONC. (µg/L)	ERA CERT. VALUE (µg/L)	RPD (%)	ACTUAL CONC. (µg/L)	ERA CERT. VALUE (µg/L)	RPD (%)	ACTUAL CONC. (µg/L)	ERA CERT. VALUE (µg/L)	RPD (%)	AVG.† (%)
ARSENIC	165	133	11	130	152	-8	55	75.8	-16	70	43.6	23	124	131	-3	2
CADMIUM	78	78	0	105	102	1	96	97.9	-1	280	230	10	80	54.1	19	6
CHROMIUM	87	91	-2	175	161	4	100	99	1	200	172	8	300	257	8	4
COPPER	70	66	3	99	91	4	135	110	10	230	200	7	90	98.5	-5	4
LEAD	95	89	3	115	141	-10	175	169	2	200	160	11	140	154	-5	0
MERCURY	10	11	-5	11.2	9.6	8	4.6	3.8	10	4.5	3.4	14	4.4	3.4	13	8
NICKEL	74	77	-2	87	83	2	140	141	0	60	74.1	-11	80	131	-24	-7
SELENIUM	72	79	-5	134	137	-1	60	68	-6	26	49.1	-31	70	81.8	-8	-10
SILVER	75	79	-3	-	80	NC	-	-	NC	50	170	-55	20	40	-33	-30
ZINC	160	134	9	192	163	8	185	183	1	300	260	7	220	188	8	7
TKN	5	5.0	0	4.6	3	21	2.8	4	-18	3.7	4.6	-11	3.7	4.6	-11	-4
NITRATE as N	6.4	6.7	-2	4.4	4.5	-1	7	6.5	4	3.72	5.6	-20	-	-	NC	-5
PHOSPHATE as P	7.4	7.4	0	4.1	3.9	2	4.8	4.4	4	6.14	7.1	-7	-	-	NC	0
TSS	-	-	NC	65	71	-4	36.8	35	3	-	-	NC	78	85	-4	-2
BOD	-	-	NC	58	41	17	50	53	-3	80.2	62	13	32	43	-15	3

ERA = External Reference Standards provided by Environmental Resource Associates, Arvada, Colorado
- = Analysis Not Performed
NC = Not Calculated
AVG.† = Average of RPDs for All Available Quarterly Results

Table C.5.2 First Quarter ERA Quality Control Samples for 1988

Analyte	Reported Concentration	ERA Certified Value	ERA Target Range	Comments
Oil and Grease	30 mg/bottle	35 mg/bottle	28-42 mg/bottle	
TRACE METALS	(ug/L)	(ug/L)	(ug/L)	
Arsenic	165	133	133-160	Conc. out of target range.
Cadium	78	78	62-94	
Chromium	87	91	73-109	
Copper	70	66	53-79	
Lead	95	89	71-107	
Mercury	10	11.0	8.8-13.0	
Nickel	74	77	62-92	
Selenium	72	79	63-95	
Silver	75	79	63-95	
Zinc	160	134	107-161	
Conventional Constituents				
pH	Value not reported.	9.1	8.9-9.3.	
	(mg/L)	(mg/L)	(mg/L)	
BOD(5 day)	Value not reported.	65	49-81	
TOC	Value not reported.	43	34-52	
Kjeldahl nitrogen as N	5	5.0	3.9-6.1	
	(mg/L)	(mg/	(mg/L)	
Ammonia as N	6.6	6.[illegible]	5.7-7.3	
Nitrate as N	6.4	6.7	5.9-7.5	
Phosphate as P	7.4	7.4	6.6-8.2	

Table C.5.2 First Quarter ERA Quality Control Samples for 1988

Analyte	Reported Concentration	ERA Certified Value	ERA Target Range	Comments
VOLATILES (GC/MS)	(ug/L)	(ug/L)	(ug/L)	
chlorobenzene	74	73.1	27-100	
chloroform	15	13.9	10-17	
1,2-dichloroethane	46	46.3	31-66	
ethylbenzene	30	32.1	12-43	
methylene chloride	110	112	39-230	
1,1,1-trichloroethane	140	143	74-220	
trichloroethene	56	54.3	39-75	
SEMIVOLATILE (GC/MS)	(ug/L)	(ug/L)	(ug/L)	
acenaphthene	50	65.1	21-94	
bis(2-chloroethyl)ether	66	136	16-212	
4-chlorophenyl phenyl ether	55	64.8	28-102	
di-n-butyl phthalate	87	97.5	15-115	
diethyl phthalate	70	70.5	17-80	
naphthalene	100	173	66-230	
n-nitroso-di-n-propylamine	14	22.8	9-52	
1,2,4-trichlorobenzene	24	62.9	28-89	Conc. out of target range.
PESTICIDES (GC)	(ug/L)	(ug/L)	(ug/L)	
beta-BHC	0.76	0.88	0.31-1.3	
gamma-BHC (Lindane)	0.58	0.39	0.21-0.56	Conc. out of target range.
heptchlor	2.7	2.85	1.9-3.8	
endrin	1.0	1.44	0.6-2.2	
PCB'S (GC)				
Aroclor 1242	0.35	0.219	0.085-0.33	Conc. out of target range.
Toxaphene	0.47	0.263	0.11-0.33	Conc. out of target range.

Table C.5.2 First Quarter ERA Quality Control Samples for 1988

Analyte	Reported Concentration	ERA Certified Value	ERA Target Range	Comments
HERBICIDES (GC)	(mg/L)	(mg/L)	(mg/L)	
2,4-D	0.31	0.540	0.14-0.66	
2,4,5-TP	0.35	0.320	0.11-0.45	

Table C.5.3 Second Quarter ERA Quality Control Samples for 1988

Analyte	Reported Concentration	ERA Certified Value	ERA Target Range	Comments
Oil and Grease	35 mg/bottle	45 mg/bottle	35-55 mg/bottle	
TRACE METALS	(ug/L)	(ug/L)	(ug/L)	
Arsenic	130	152	122-182	
Cadium	105	102	82-122	
Chromium	175	161	129-193	
Copper	99	91	73-109	
Lead	115	141	113-169	
Mercury	11.2	9.6	7.7-12.0	
Nickel	87	83	66-100	
Selenium	134	137	110-164	
Silver	Conc. not reported	80	64-96	
Zinc	192	163	134-202	
Conventional Constituents				
pH	8.9	9.1	8.9-9.3	
	(mg/L)	(mg/L)	(mg/L)	
BOD(5 day)	58	41	31-51	Conc. out of target range.
TOC	Conc. not reported	27	21-33	
Kjeldahl nitrogen as N	4.6	3	2.4-3.6	Conc. out of target range.
	(mg/L)	(mg/L)	(mg/L)	
Total Suspended Soilds	65	71	59-83	
	(mg/L)	(mg/L)	(mg/L)	
Ammonia as N	5.7	5.7	5.0-6.4	
Nitrate as N	4.4	4.5	4.0-5.0	
Phosphate as P	4.1	3.9	3.5-4.3	

Table C.5.3 Second Quarter ERA Quality Control Samples for 1988

Analyte	Reported Concentration	ERA Certified Value	ERA Target Range	Comments
VOLATILES (GC/MS)	(ug/L)	(ug/L)	(ug/L)	
chloroform	35	23.7	16-29	Conc. out of target range.
1,2-dichloroethane	92	78.8	39-108	
bromodichloromethane	11	8.9	4-12	
trans-1,3-dichloropropene	42	26.3	10-43	
toluene	180	160	75-214	
ethylbenzene	101	96.5	36-129	
SEMIVOLATILE (GC/MS)	(ug/L)	(ug/L)	(ug/L)	
acenaphthene	31	75.1	35-109	Conc. out of target range.
benzo(b)fluoranthene	23	45.5	11-72	
benzo(a)pyrene	Not detected	15.9	3-26	Conc. out of target range.
bis(2-ethylhexyl)phthalate	43	102	29-161	
2-chloronapthalene	Not detected	21.1	13-25	Conc. out of target range.
1,3-dichlorobenzene	24	98	25-169	Conc. out of target range.
2,4-dinitrotoluene	54	130	51-181	
hexachlorobutadiene	12	62.9	15-73	Conc. out of target range.
nitrobenzene	49	88	31-158	
HERBICIDES (GC)	(mg/L)	(mg/L)	(mg/L)	
2,4-D	0.11	0.111	0.030-0.135	
2,4,5-TP	[illegible]	0.185	0.065-0.259	

Table C.5.4 Third Quarter ERA Quality Control Samples for 1988

Analyte	Reported Concentration	EPA Certified Value	ERA Target Range	Comments
Oil and Grease	15 mg/bottle	20 mg/bottle	16-24 mg/bottle	Conc. out of target range.
TRACE METALS	(ug/L)	(ug/L)	(ug/L)	
Arsenic	55	75.8	55-95	
Cadium	96	97.9	73-122	
Chromium	100	99	74-124	
Copper	135	110	83-138	
Lead	175	169	127-211	
Mercury	4.6	3.8	2.8-4.8	
Nickel	140	141	106-176	
Selenium	60	68	57-85	
Zinc	185	183	137-229	
Conventional Constituents				
pH	9.2	8.8	8.6-9.0	
	(mg/L)	(mg/L)	(mg/L)	
BOD(5 day)	50	53	40-66	
TOC	30	35	27-43	
Kjeldahl nitrogen as N	2.8	4	3.2-4.8	Conc. out of target range.
Total Suspended Solids	36.8	35	29-41	
	(mg/L)	(mg/L)	(mg/L)	
Ammonia as N	4.6	3.8	3.3-4.3	Conc. out of target range.
Nitrate as N	7	6.5	5.8-7.2	
Phosphate as P	4.8	4.4	3.6-5.2	

Table C.5.4 Third Quarter ERA Quality Control Samples for 1988

Analyte	Reported Concentration	EPA Certified Value	ERA Target Range	Comments
VOLATILES (GC/MS)	(ug/L)	(ug/L)	(ug/L)	
Methylene Chloride	85	77	27-160	
1,1-Dichloroethane	25	23.3	11-33	
Carbon Tetrachloride	15	12.3	8.8-76	
Benzene	70	58.3	22-76	
Chlorobenzene	19	15.5	5.7-21	
1,1,2,2-Tetrachloroethane	140	132	60-179	
SEMI-VOLATILE (GC/MS)	(ug/L)	(ug/L)	(ug/L)	
1,4-Dichlorobenzene	Not detected	9.65	4.1-12	
Hexachloroethane	Not detected	24.2	9.7-27	Conc. out of target range.
1,2,4-Trichlorobenzene	14	62.6	27-89	Conc. out of target range.
2-Chloronaphthalene	Not detected	13	7.8-15	Conc. out of target range.
Acenaphthylene	Not detected	44.8	15-65	Conc. out of target range.
Acenphthene	20	Not reported		Not in ERA sample.
2,4-dinitrotoluene	91	143	56-199	
Butylbenzylphthalate	63	93.7	14-142	
Bis(2-ethylhexyl)phthalate	33	79.3	22-125	
PESTICIDES (GC)	(ug/L)	(ug/L)	(ug/L)	
Aldrin	0.11	1.42	0.62--1.7	Conc. out of target range.
Heptachlor epoxide	ND	0.385	0.17--0.55	Conc. below laboratory detection limit.
4,4'-DDD	0.095	0.135	0.06--0.16	
4,4'-DDE	0.08	0.26	0.08--0.37	
4,4'-DDT	0.23	Not reported		Not in ERA sample.
Dieldrin	0.083	Not reported		Not in ERA sample.
Endrin	0.06	Not reported		Not in ERA sample.
PCB'S (GC)	(ug/L)	(ug/L)	(ug/L)	
Aroclor 1242	ND	0.219	0.085-0.33	Conc. below laboratory detection limit.

Table C.5.4 Third Quarter ERA Quality Control Samples for 1988

Analyte	Reported Concentration	EPA Certified Value	ERA Target Range	Comments
Toxaphene	ND	0.263	0.11-0.33	Conc. below laboratory detection limit.
HERBICIDES (GC)	(mg/L)	(mg/L)	(mg/L)	
2,4-D	0.3	0.540	0.14-0.66	
2,4,5-TP	0.33	0.320	0.11-0.45	

Table C.5.5 Fourth Quarter ERA Quality Control Samples for 1988

Analyte	Reported Concentration	ERA Certified Value	ERA Target Range	COMMENTS
Oil and Grease	38 mg/bottle	37 mg/bottle	29-45 mg/bottle	
TRACE METALS	(mg/L)	(mg/L)	(mg/L)	
Arsenic	70	43.6	33-54	Conc. out of target range.
Cadium	280	230	172-288	
Chromium	200	172	129-215	
Copper	230	200	150-250	
Lead	200	160	121-200	
Mercury	4.5	3.4	2.6-4.2	Conc. out of target range.
Nickel	60	74.1	56-93	
Selenium	26	49.1	37-61	Conc. out of target range.
Silver	50	170	110-210	Conc. out of target range.
Zinc	300	260	195-325	
Conventional Constituents				
pH	9.17	9	8.8-9.2	
	(mg/L)	(mg/L)	(mg/L)	
BOD(5 day)	80.2	62	46-78	Conc. out of target range.
TOC				
Kjeldahl nitrogen as N	3.7	4.6	3.7-5.5	
	(mg/L)	[illegible]	(mg/L)	
Ammonia as N	3.65	5.3	4.6-6.0	Conc. out of target range.
Nitrate as N	3.72	5.6	5.0-6.2	Conc. out of target range.
Phosphate as P	6.14	7.1	5.8-8.4	

Table C.5.5 Fourth Quarter ERA Quality Control Samples for 1988

Analyte	Reported Concentration	ERA Certified Value	ERA Target Range	COMMENTS
VOLATILES (GC/MS)	(ug/L)	(ug/L)	(ug/L)	
1,1-dichloroethene	130	112	21-230	
Methylene chloride	87	85.5	30-170	
Trans-1,2-dichloroethene	16	15.3	10-20	
Toluene	19	13.5	7-22	
1,1,2-trichloroethane	98	100	52-140	
Tetrachloroethene	25	22.1	14-29	
SEMI-VOLATILE (GC/MS)	(ug/L)	(ug/L)	(ug/L)	
1,4-dichlorobenzene	31	237	60-390	Conc. out of target range.
bis(2-chloroisopropyl)Ether	14	68.7	25-110	Conc. out of target range.
Diethylphthalate	20	59.4	14-68	
Phenanthrene	12	23.6	12-28	
Fluoranthene	28	43.7	26-60	
Butylbenzyphthalate	41	139	21-210	
PESTICIDES (GC)	(ug/L)	(ug/L)	(ug/L)	
Aldrin	0.12	0.143	0.063-0.17	
Dieldrin	0.52	0.574	0.23-0.81	
Endrin	0.26	0.357	0.11-0.53	
PCB'S (GC)	(ug/L)	(ug/L)	(ug/L)	
Aroclor 1221	Not Detected	0.148	0.035-0.26	Conc. below laboratory detection limit.
HERBICIDES (GC)	(mg/L)	(mg/L)	(mg/L)	
2,4-D	Not Detected	0.625	0.17-0.79	Conc. below laboratory detection limit.
2,4,5-TP	Not Detected	0.173	0.061-0.24	Conc. below laboratory detection limit.

Table C.5.6 First Quarter ERA Quality Control Samples for 1989

Analyte	Reported Concentration	ERA Certified Value	ERA Target Range	Comments
Oil and Grease	64 mg/bottle	55 mg/bottle	46-66 mg/bottle	
TRACE METALS	(ug/L)	(ug/L)	(ug/L)	
Arsenic	124	131	98-164	
Cadium	80	54.1	40-68	Conc. out of target range.
Chromium	300	257	192-321	
Copper	90	98.5	74-123	
Lead	140	154	115-192	
Mercury	4.4	3.4	2.6-4.2	Conc. out of target range.
Nickel	80	131	98-164	
Selenium	70	81.8	61-102	
Silver	20	40	21-65	
Zinc	220	188	141-235	
Conventional Constituents				
pH	9.1	8.9	8.7-9.1	
	(mg/L)	(mg/L)	(mg/L)	
BOD(5 day)	32	43	30-66	
TOC	23	28	22-34	
Kjeldahl nitrogen as N	3.7	4.6	3.7-5.5	
Total Suspended Solids	78	85	71-99	
PESTICIDES (GC)	(ug/L)	(ug/L)	(ug/L)	
gamma-BHC (lindane)	0.1	0.098	0.028-0.14	
Dieldrin	0.064	0.073	0.029-0.1	
Endrin	0.1	0.12	0.037-0.18	
Endrin aldehyde	ND	0.064	0.022-0.094	Conc. below laboratory detection limit.
PCB'S (GC)	(ug/L)	(ug/L)	(ug/L)	
Aroclor 1221	ND	0.967	0.14-1.3	Conc. below laboratory detection limit.

APPENDIX D
SANTA CLARA NONPOINT SOURCE WATER AND SEDIMENT QUALITY DATA

APPENDIX D
SANTA CLARA NONPOINT SOURCE WATER AND SEDIMENT QUALITY DATA

The following section presents the water and sediment quality data collected for the Santa Clara Valley Nonpoint Source study. The data are organized by parameter type (e.g., metals, conventional, etc.) and are titled D.1 through D.7. Under each parameter type the data are further subdivided into water samples and sediment samples. In addition, the metals include subgroups for total and dissolved concentrations in the water column. Following is a list of the parameter types and the corresponding appendix section:

- D.1 Metals
    - D.1-1 Total metals in water column
    - D.1-2 Dissolved metals in water column
    - D.1-3 Total metals in sediment
- D.2 Conventional parameters
    - D.2-1 Conventional parameters in water column
    - D.2-2 Conventional parameters in sediment
- D.3 Organochlorine pesticides
    - D.3-1 Organochlorine pesticides in water column
    - D.3-2 Organochlorine pesticides in sediment
- D.4 Chlorinated herbicides
    - D.4-1 Chlorinated herbicides and TOX in water column
    - D.4-2 Chlorinated herbicides in sediment
- D.5 Organophosphate pesticides
    - D.5-1 Organophosphate pesticides in water column
    - D.5-2 Organophosphate pesticides in sediment

- D.6 Polynuclear aromatic hydrocarbons
  - D.6-1 Polynuclear aromatic hydrocarbons in water column
  - D.6-2 Polynuclear aromatic hydrocarbons in sediment
- D.7 Volatiles and semi-volatiles
  - D.7-1 Volatiles and semi-volatiles in water column
  - D.7-2 Volatiles and semi-volatiles in sediment
- D.8 Dissolved oxygen data from stream stations and settling data

Within each parameter subgroup, the data are further organized by sample I.D. along rows and with the parameters sampled along columns. The sample I.D. corresponds to the sampling station identification number (e.g., L1 through L7 for land use stations, S1 through S4 for stream stations, and R1 through R6 for reservoir release stations). Under each sample I.D. the data are again subdivided into samples collected during dry (DRY) and wet (WET) weather, when appropriate. Also shown under sample I.D. are field duplicate (FD), lab replicates (LR), and field blanks (FB).

Under each parameter type are the measured concentrations (or ND if non-detected) and the value of the detection limit for the sample collected. Blanks in the data set mean that an analysis was not performed for certain parameters (such as hexavalent chromium) during a particular sampling event.

D.1 Metals

D.1-1 Total metals in water column

Sample I.D.	Date Sampled Month	Day	Year	Sample Type	Sample Event	Arsenic actual mg/l	D.L. mg/l	Cadmium actual mg/l	D.L. mg/l	Chromium actual mg/l	D.L. mg/l	Hexav Cr actual mg/l	D.L. mg/l	Copper actual mg/l	D.L. mg/l	Lead actual mg/l	D.L. mg/l
======	=====	===	=====	======	=====	======	======	======	======	======	======	======	======	======	======	======	======
STANDARD REPORTING OBJECTIVES							0.001		0.0001		0.001				0.001		0.001
L1	4	20	1988	WET	1	0.001	0.001	ND	0.0002	0.006	0.001			0.021	0.001	0.018	0.001
L1	11	23	1988	WET	2	ND	0.001	0.001	0.0002	0.009	0.001			0.028	0.001	0.045	0.001
L1	2	4	1989	WET	4	ND	0.001	0.0021	0.0002	0.035	0.001	ND	0.01	0.026	0.001	0.059	0.001
L1	2	9	1989	WET	5	ND	0.001	0.0035	0.0002	0.019	0.001	ND	0.01	0.065	0.001	0.595	0.001
L1	3	2	1989	WET	6	ND	0.001	0.0014	0.0002	0.012	0.001	ND	0.01	0.055	0.001	0.035	0.001
L2	4	20	1988	WET	1	0.002	0.001	0.0052	0.0002	0.018	0.001			0.051	0.001	0.095	0.001
L2	11	23	1988	WET	2	ND	0.001	0.004	0.0002	0.21	0.001			0.051	0.001	0.14	0.001
L2	2	4	1989	WET	4	ND	0.001	0.0035	0.0002	0.042	0.001	ND	0.01	0.046	0.001	0.33	0.001
L2	2	9	1989	WET	5	ND	0.001	0.0052	0.0002	0.075	0.001	ND	0.01	0.047	0.001	0.238	0.001
L2	3	2	1989	WET	6	ND	0.001	0.0095	0.0002	0.038	0.001	ND	0.01	0.060	0.001	0.11	0.001
L2	3	25	1989	WET	7	0.001	0.001	0.0047	0.0002	0.038	0.001	NR	0.01	0.039	0.001	0.075	0.001
L3	4	20	1988	WET	1	0.001	0.001	0.0004	0.0002	0.007	0.001			0.026	0.001	0.053	0.001
L3	11	23	1988	WET	2	ND	0.001	0.001	0.0002	0.007	0.001			0.014	0.001	0.03	0.001
L3	2	4	1989	WET	4	ND	0.001	0.0019	0.0002	0.001	0.001	ND	0.01	0.016	0.001	0.077	0.001
L3	2	9	1989	WET	5	ND	0.001	0.0035	0.0002	0.016	0.001	ND	0.01	0.025	0.001	0.045	0.001
L3	3	2	1989	WET	6	ND	0.001	0.0012	0.0002	0.008	0.001	ND	0.01	0.033	0.001	0.035	0.001
L3	3	25	1989	WET	7	ND	0.001	0.0013	0.0002	0.015	0.001	ND	0.01	0.022	0.001	0.055	0.001
L4	2	4	1989	WET	4	ND	0.001	0.0012	0.0002	0.032	0.001	ND	0.01	0.012	0.001	0.003	0.001
L4	2	9	1989	WET	5	ND	0.001	0.0017	0.0002	0.021	0.001	ND	0.01	0.028	0.001	0.004	0.001
L4	3	25	1989	WET	7	ND	0.001	0.0006	0.0002	0.023	0.001	ND	0.01	0.033	0.001	0.007	0.001
L5	11	23	1988	WET	2	ND	0.001	0.003	0.0002	0.044	0.001			0.32	0.001	0.315	0.001
L5	1	23	1989	WET	3	ND	0.001	0.0009	0.0002	0.003	0.001	ND	0.01	ND	0.001	ND	0.001
L5	2	4	1989	WET	4	ND	0.001	0.0028	0.0002	0.028	0.001	ND	0.01	0.032	0.001	0.05	0.001
L5FD	2	4	1989	WET	4	ND	0.001	0.0026	0.0002	0.011	0.001	ND	0.01	0.019	0.001	0.042	0.001
L5	2	9	1989	WET	5	ND	0.001	0.0035	0.0002	0.019	0.001	ND	0.01	0.070	0.001	0.091	0.001
L5	3	2	1989	WET	6	ND	0.001	0.0013	0.0002	0.017	0.001	ND	0.01	0.050	0.001	0.045	0.001
L5FD	3	2	1989	WET	6	ND	0.001	0.0012	0.0002	0.017	0.001	ND	0.01	0.050	0.001	0.050	0.001
L5	3	25	1989	WET	7	ND	0.001	0.0011	0.0002	0.019	0.001	ND	0.01	0.044	0.001	0.11	0.001
L6	4	20	1988	WET	1	0.003	0.001	0.0012	0.0002	0.021	0.001			0.088	0.001	0.09	0.001
L6	11	23	1988	WET	2	ND	0.001	0.001	0.0002	0.016	0.001			0.054	0.001	0.11	0.001
L6	2	9	1989	WET	5	ND	0.001	0.0035	0.0002	0.014	0.001	ND	0.01	0.023	0.001	0.007	0.001
L6	3	2	1989	WET	6	0.002	0.001	0.0015	0.0002	0.074	0.001	ND	0.01	0.039	0.001	0.030	0.001
L6	3	25	1989	WET	7	0.002	0.001	0.0014	0.0002	0.023	0.001	ND	0.01	0.055	0.001	0.13	0.001
L7	11	23	1988	WET	2	ND	0.001	0.0004	0.0002	0.009	0.001			0.011	0.001	0.016	0.001
L7	2	4	1989	WET	4	ND	0.001	0.0007	0.0002	0.002	0.001	ND	0.01	ND	0.001	ND	0.001
L7	2	9	1989	WET	5	ND	0.001	0.0017	0.0002	0.012	0.001	ND	0.01	0.016	0.001	ND	0.001
L7	3	2	1989	WET	6	0.004	0.001	ND	0.0002	0.005	0.001	ND	0.01	0.004	0.001	0.001	0.001
L7	3	25	1989	WET	7	ND	0.001	0.0002	0.0002	0.022	0.001	NR	0.01	0.011	0.001	0.003	0.001
R1	2	27	1988	RES	1	0.003	0.001	ND	0.0002	0.006	0.001			0.006	0.001	0.002	0.001
R2	2	26	1988	RES	1	0.002	0.001	ND	0.0002	0.003	0.001			0.007	0.001	0.002	0.001
R3	2	27	1988	RES	1	0.002	0.001	ND	0.0002	0.003	0.001			0.005	0.001	0.002	0.001
R4	2	27	1988	RES	1	0.007	0.001	ND	0.0002	0.19	0.001			0.007	0.001	0.002	0.001
R5	2	27	1988	RES	1	0.004	0.001	ND	0.0002	0.0044	0.001			0.004	0.001	ND	0.001
R6	2	27	1988	RES	1	0.001	0.001	0.0007	0.0002	0.005	0.001			0.007	0.001	0.002	0.001

Sample I.D.	Date Sampled Month	Day	Year	Sample Type	Sample Event	Arsenic actual mg/l	D.L. mg/l	Cadmium actual mg/l	D.L. mg/l	Chromium actual mg/l	D.L. mg/l	Hexav Cr actual mg/l	D.L. mg/l	Copper actual mg/l	D.L. mg/l	Lead actual mg/l	D.L. mg/l
STANDARD REPORTING OBJECTIVES							0.001		0.0001		0.001				0.001		0.001
S1	2	26	1988	DRY	1	0.001	0.001	ND	0.0002	0.005	0.001			0.011	0.001	ND	0.001
S1	3	30	1988	DRY	2									0.051	0.001	0.0006	0.0005
S1LR	3	30	1988	DRY	2									0.052	0.001	0.0008	0.0005
S1	5	11	1988	DRY	3									0.007	0.001	0.0018	0.0002
S1	12	12	1988	DRY	5							ND	0.01	0.007	0.001	ND	0.001
S1	2	1	1989	DRY	6	ND	0.001	0.0003	0.0002	0.001	0.001	ND	0.01	ND	0.001	ND	0.001
S1	4	6	1989	DRY	7	ND	0.001	ND	0.0002	0.001	0.001	ND	0.01	0.006	0.001	ND	0.001
S1	11	23	1988	WET	2	ND	0.001	0.002	0.0002	0.046	0.001			0.095	0.001	0.099	0.001
S1	1	23	1989	WET	3	ND	0.001	0.0007	0.0002	0.002	0.001	ND	0.01	ND	0.001	0.004	0.001
S1	2	4	1989	WET	4	ND	0.001	0.0026	0.0002	0.007	0.001	ND	0.01	0.03	0.001	0.06	0.001
S1	2	9	1989	WET	5	ND	0.001	0.0035	0.0002	0.019	0.001	ND	0.01	0.032	0.001	0.032	0.001
S1FD	2	9	1989	WET	5	ND	0.001	0.0035	0.0002	0.019	0.001	ND	0.01	0.030	0.001	0.039	0.001
S1	3	2	1989	WET	6	0.003	0.001	0.0011	0.0002	0.026	0.001	ND	0.01	0.044	0.001	0.005	0.001
S1	3	25	1989	WET	7	0.004	0.001	0.0013	0.0002	0.027	0.001	ND	0.01	0.055	0.001	0.060	0.001
S1FD	3	25	1989	WET	7	0.002	0.001	0.0015	0.0002	0.036	0.001	ND	0.01	0.061	0.001	0.10	0.001
S2	2	26	1988	DRY	1	0.002	0.001	ND	0.0002	0.006	0.001			0.008	0.001	0.002	0.001
S2	3	30	1988	DRY	2									0.01	0.001	0.0016	0.0005
S2	5	11	1988	DRY	3									0.006	0.001	0.0012	0.0002
S2	12	12	1988	DRY	5							ND	0.01	ND	0.001	ND	0.001
S2	2	1	1989	DRY	6	ND	0.001	0.0004	0.0002	0.002	0.001	ND	0.01	ND	0.001	ND	0.001
S2	4	6	1989	DRY	7	ND	0.001	0.0006	0.0002	0.003	0.001	ND	0.01	0.003	0.001	ND	0.001
S2	4	20	1988	WET	1	0.003	0.001	0.0009	0.0002	0.03	0.001			0.072	0.001	0.072	0.001
S2	11	23	1988	WET	2	ND	0.001	0.002	0.0002	0.093	0.001			0.32	0.001	0.27	0.001
S2	1	23	1989	WET	3	ND	0.001	0.006	0.0002	0.004	0.001	ND	0.01	0.003	0.001	0.001	0.001
S2FD	1	23	1989	WET	3	ND	0.001	0.0004	0.0002	0.003	0.001	ND	0.01	0.002	0.001	0.002	0.001
S2	2	4	1989	WET	4	ND	0.001	0.0053	0.0002	0.019	0.001	ND	0.01	0.023	0.001	0.035	0.001
S2	2	9	1989	WET	5	ND	0.001	0.0035	0.0002	0.026	0.001	ND	0.01	0.060	0.001	0.081	0.001
S2	3	2	1989	WET	6	0.003	0.001	0.0014	0.0002	0.029	0.001	ND	0.01	0.050	0.001	0.035	0.001
S2	3	25	1989	WET	7	ND	0.001	0.0015	0.0002	0.050	0.001	ND	0.01	0.060	0.001	0.050	0.001
S3	2	26	1988	DRY	1	0.001	0.001	ND	0.0002	0.006	0.001			0.003	0.001	0.002	0.001
S3	3	30	1988	DRY	2									0.004	0.001	0.0023	0.0005
S3	5	11	1988	DRY	3									0.005	0.001	0.0028	0.0002
S3	8	25	1988	DRY	4									0.011	0.001	ND	0.001
S3FD	8	25	1988	DRY	4									0.007	0.001	0.014	0.001
S3	12	12	1988	DRY	5							ND	0.01	0.003	0.001	ND	0.001
S3FD	12	12	1988	DRY	5							ND	0.01	ND	0.001	ND	0.001
S3	2	1	1989	DRY	6	ND	0.001	ND	0.0002	0.003	0.001	ND	0.01	ND	0.001	ND	0.001
S3LR	2	1	1989	DRY	6	ND	0.001	0.0006	0.0002	0.003	0.001	ND	0.01	ND	0.001	ND	0.001
S3FD	2	1	1989	DRY	6	ND	0.001	0.0002	0.0002	0.003	0.001	ND	0.01	0.004	0.001	0.004	0.001
S3	4	6	1989	DRY	7	0.001	0.001	ND	0.0002	0.002	0.001	ND	0.01	0.004	0.001	ND	0.001
S3FD	4	6	1989	DRY	7	0.001	0.001	0.0031	0.0002	ND	0.001	ND	0.01	0.003	0.001	ND	0.001
S3	4	20	1988	WET	1	0.005	0.001	0.0016	0.0002	0.082	0.001			0.088	0.001	0.088	0.001
S3	11	23	1988	WET	2	ND	0.001	0.001	0.0002	0.12	0.001			0.17	0.001	0.35	0.001
S3LR	11	23	1988	WET	2	ND	0.001	0.0007	0.0002	0.11	0.001			0.15	0.001	0.2	0.001
S3	1	23	1989	WET	3	ND	0.001	0.0010	0.0002	0.014	0.001	ND	0.01	0.006	0.001	0.007	0.001
S3	2	4	1989	WET	4	ND	0.001	0.0019	0.0002	0.016	0.001	ND	0.01	0.06	0.001	0.091	0.001
S3	2	9	1989	WET	5	ND	0.001	0.0035	0.0002	0.051	0.001	ND	0.01	0.075	0.001	0.11	0.001
S3	3	2	1989	WET	6	ND	0.001	0.0007	0.0002	0.022	0.001	ND	0.01	0.033	0.001	0.012	0.001

Sample I.D.	Date Sampled Month	Day	Year	Sample Type	Sample Event	Mercury actual mg/l	D.L. mg/l	Nickel actual mg/l	D.L. mg/l	Selenium actual mg/l	D.L. mg/l	Silver actual mg/l	D.L. mg/l	Zinc actual mg/l	D.L. mg/l
STANDARD REPORTING OBJECTIVES							0.0002		0.001		0.0002		0.0001		0.001
L1	4	20	1988	WET	1	ND	0.0002	0.016	0.001	ND	0.002	0.0003	0.0001	0.12	0.01
L1	11	23	1988	WET	2	0.0012	0.0002	0.047	0.001	ND	0.0003	0.0002	0.0002	0.15	0.001
L1	2	4	1989	WET	4	ND	0.0002	0.039	0.002	ND	0.0002	0.0002	0.0002	0.26	0.001
L1	2	9	1989	WET	5	ND	0.0002	0.018	0.002	ND	0.0002	0.002	0.0002	0.35	0.001
L1	3	2	1989	WET	6	0.0002	0.0002	0.45	0.002	ND	0.0002	0.0013	0.0002	0.40	0.001
L2	4	20	1988	WET	1	0.0002	0.0002	0.029	0.001	ND	0.002	0.0003	0.0001	1.7	0.01
L2	11	23	1988	WET	2	0.0044	0.0002	0.04	0.001	ND	0.0003	0.0004	0.0002	0.95	0.001
L2	2	4	1989	WET	4	0.0007	0.0002	0.04	0.002	ND	0.0002	0.0005	0.0002	0.37	0.001
L2	2	9	1989	WET	5	ND	0.0002	0.035	0.002	ND	0.0002	0.007	0.0002	1.8	0.001
L2	3	2	1989	WET	6	ND	0.0002	0.08	0.002	ND	0.0002	0.0010	0.0002	2.0	0.001
L2	3	25	1989	WET	7	ND	0.0002	0.08	0.002	ND	0.0002	0.0020	0.0002	0.70	0.001
L3	4	20	1988	WET	1	ND	0.0002	0.015	0.001	ND	0.002	0.0004	0.0001	0.2	0.01
L3	11	23	1988	WET	2	ND	0.0002	0.018	0.001	ND	0.0003	ND	0.0002	0.14	0.001
L3	2	4	1989	WET	4	0.0005	0.0002	0.019	0.002	ND	0.0002	ND	0.0002	0.22	0.001
L3	2	9	1989	WET	5	ND	0.0002	ND	0.002	ND	0.0002	ND	0.0002	0.18	0.001
L3	3	2	1989	WET	6	0.0002	0.0002	0.03	0.002	ND	0.0002	ND	0.0002	0.26	0.001
L3	3	25	1989	WET	7	0.0002	0.0002	0.04	0.002	ND	0.0002	0.0001	0.0002	0.32	0.001
L4	2	4	1989	WET	4	0.0005	0.0002	0.014	0.002	0.0004	0.0002	0.0005	0.0002	0.06	0.001
L4	2	9	1989	WET	5	ND	0.0002	0.018	0.002	0.0005	0.0002	0.0005	0.0002	0.088	0.001
L4	3	25	1989	WET	7	ND	0.0002	0.06	0.002	0.001	0.0002	0.0030	0.0002	0.020	0.001
L5	11	23	1988	WET	2	0.003	0.0002	0.053	0.001	ND	0.0003	ND	0.0002	0.36	0.001
L5	1	23	1989	WET	3	ND	0.0002	ND	0.002	ND	0.0002	ND	0.0002	0.24	0.001
L5	2	4	1989	WET	4	0.0004	0.0002	0.025	0.002	ND	0.0002	ND	0.0002	0.2	0.001
L5FD	2	4	1989	WET	4	0.0006	0.0002	0.021	0.002	ND	0.0002	ND	0.0002	0.18	0.001
L5	2	9	1989	WET	5	ND	0.0002	0.018	0.002	ND	0.0002	ND	0.0002	0.53	0.001
L5	3	2	1989	WET	6	ND	0.0002	0.06	0.002	ND	0.0002	ND	0.0002	0.31	0.001
L5FD	3	2	1989	WET	6	0.0002	0.0002	0.05	0.002	ND	0.0002	ND	0.0002	0.32	0.001
L5	3	25	1989	WET	7	ND	0.0002	0.06	0.002	ND	0.0002	0.0002	0.0002	0.24	0.001
L6	4	20	1988	WET	1	0.0006	0.0002	0.031	0.001	ND	0.002	0.0003	0.0001	0.3	0.01
L6	11	23	1988	WET	2	0.002	0.0002	0.028	0.001	ND	0.0003	ND	0.0002	0.24	0.001
L6	2	9	1989	WET	5	ND	0.0002	ND	0.002	ND	0.0002	ND	0.0002	0.18	0.001
L6	3	2	1989	WET	6	ND	0.0002	0.11	0.002	ND	0.0002	ND	0.0002	0.20	0.001
L6	3	25	1989	WET	7	ND	0.0002	0.07	0.002	ND	0.0002	0.0002	0.0002	0.30	0.001
L7	11	23	1988	WET	2	0.002	0.0002	0.004	0.001	ND	0.0003	ND	0.0002	0.011	0.001
L7	2	4	1989	WET	4	0.0011	0.0002	0.009	0.002	ND	0.0002	ND	0.0002	0.021	0.001
L7	2	9	1989	WET	5	ND	0.0002	ND	0.002	ND	0.0002	ND	0.0002	ND	0.001
L7	3	2	1989	WET	6	0.0002	0.0002	0.006	0.002	0.001	0.0002	0.0002	0.0002	0.005	0.001
L7	3	25	1989	WET	7	ND	0.0002	0.09	0.002	ND	0.0002	0.0003	0.0002	0.012	0.001
R1	2	27	1988	RES	1	ND	0.0002	0.005	0.001	ND	0.0005	0.0004	0.0002	0.009	0.001
R2	2	26	1988	RES	1	ND	0.0002	0.003	0.001	ND	0.0005	0.0012	0.0002	0.005	0.001
R3	2	27	1988	RES	1	ND	0.0002	0.008	0.001	ND	0.0005	0.0002	0.0002	0.007	0.001
R4	2	27	1988	RES	1	ND	0.0002	0.027	0.001	ND	0.0005	ND	0.0002	0.01	0.001
R5	2	27	1988	RES	1	ND	0.0002	0.004	0.001	ND	0.0005	0.0003	0.0002	0.001	0.001
R6	2	27	1988	RES	1	ND	0.0002	0.003	0.001	ND	0.0005	0.0008	0.0002	0.016	0.001

Sample I.D.	Date Sampled			Sample Type	Sample Event	Mercury		Nickel		Selenium		Silver		Zinc	
	Month	Day	Year			actual mg/l	D.L. mg/l	actual mg/l	D.L. mg/l	actual mg/l	D.L. mg/l	actual mg/l	D.L. mg/l	actual mg/l	D.L. mg/l
======	=====	===	=====	======	=====	======	======	======	======	======	======	======	======	======	======
STANDARD REPORTING OBJECTIVES							0.0002		0.001		0.0002		0.0001		0.001
S1	2	26	1988	DRY	1	ND	0.0002	ND	0.002	ND	0.0002	0.0007	0.0002	0.076	0.001
S1	3	30	1988	DRY	2	0.0003	0.0002			ND	0.01	0.0013	0.0005	0.003	0.001
S1LR	3	30	1988	DRY	2	ND	0.0002			ND	0.01	0.0012	0.0005	0.003	0.001
S1	5	11	1988	DRY	3	ND	0.0002			ND	0.002	0.0024	0.0002	0.012	0.002
S1	12	12	1988	DRY	5	ND	0.0002			ND	0.0002	ND	0.0002	0.012	0.001
S1	2	1	1989	DRY	6	ND	0.0002	ND	0.002	ND	0.0002	ND	0.0002	0.014	0.001
S1	4	6	1989	DRY	7	ND	0.0002	0.002	0.002	ND	0.0002	ND	0.0002	0.006	0.001
S1	11	23	1988	WET	2	0.002	0.0002	0.06	0.001	ND	0.0003	0.0002	0.0002	0.35	0.001
S1	1	23	1989	WET	3	ND	0.0002	0.003	0.002	ND	0.0002	ND	0.0002	0.05	0.001
S1	2	4	1989	WET	4	0.0006	0.0002	0.021	0.002	ND	0.0002	ND	0.0002	0.26	0.001
S1	2	9	1989	WET	5	ND	0.0002	ND	0.002	ND	0.0002	ND	0.0002	0.12	0.001
S1FD	2	9	1989	WET	5	ND	0.0002	0.018	0.002	ND	0.0002	ND	0.0002	0.18	0.001
S1	3	2	1989	WET	6	0.0002	0.0002	0.10	0.002	0.001	0.0002	0.0002	0.0002	0.23	0.001
S1	3	25	1989	WET	7	0.0002	0.0002	0.09	0.002	ND	0.0002	0.0002	0.0002	0.24	0.001
S1FD	3	25	1989	WET	7	ND	0.0002	0.11	0.002	ND	0.0002	0.0003	0.0002	0.37	0.001
S2	2	26	1988	DRY	1	ND	0.0002	ND	0.002	ND	0.0002	0.0024	0.0002	0.006	0.001
S2	3	30	1988	DRY	2	ND	0.0002			0.01	0.01	0.0076	0.0005	0.007	0.001
S2	5	11	1988	DRY	3	ND	0.0002			0.005	0.002	0.0047	0.0002	0.0075	0.002
S2	12	12	1988	DRY	5	ND	0.0002			ND	0.0002	ND	0.0002	0.006	0.001
S2	2	1	1989	DRY	6	ND	0.0002	ND	0.002	ND	0.0002	ND	0.0002	0.028	
S2	4	6	1989	DRY	7	ND	0.0002	0.003	0.002	0.004	0.0002	0.0007	0.0002	0.010	0.001
S2	4	20	1988	WET	1	0.0003	0.0002	0.029	0.001	ND	0.002	0.0007	0.0001	0.33	0.01
S2	11	23	1988	WET	2	0.003	0.0002	0.12	0.001	ND	0.0003	0.0004	0.0002	0.82	0.001
S2	1	23	1989	WET	3	ND	0.0002	ND	0.002	ND	0.0002	ND	0.0002	0.14	0.001
S2FD	1	23	1989	WET	3	ND	0.0002	ND	0.002	ND	0.0002	ND	0.0002	0.22	0.001
S2	2	4	1989	WET	4	0.0005	0.0002	0.023	0.002	ND	0.0002	ND	0.0002	0.14	0.001
S2	2	9	1989	WET	5	ND	0.0002	0.018	0.002	ND	0.0002	ND	0.0002	0.35	0.001
S2	3	2	1989	WET	6	ND	0.0002	0.12	0.002	ND	0.0002	0.0003	0.0002	0.25	0.001
S2	3	25	1989	WET	7	ND	0.0002	0.09	0.002	ND	0.0002	0.0004	0.0002	0.27	0.001
S3	2	26	1988	DRY	1	ND	0.0002	ND	0.002	ND	0.0002	0.0009	0.0002	0.008	0.001
S3	3	30	1988	DRY	2	ND	0.0002			ND	0.01	0.0015	0.0005	0.002	0.001
S3	5	11	1988	DRY	3	ND	0.0002			ND	0.002	0.003	0.0002	0.0075	0.002
S3	8	25	1988	DRY	4	0.0027	0.0002			0.0023	0.0002	0.0023	0.0005	0.009	0.001
S3FD	8	25	1988	DRY	4	0.0023	0.0002			0.0018	0.0002	0.0018	0.0005	0.014	0.001
S3	12	12	1988	DRY	5	ND	0.0002			0.0003	0.0002	ND	0.0002	0.026	0.001
S3FD	12	12	1988	DRY	5	ND	0.0002			ND	0.0002	ND	0.0002	0.014	0.001
S3	2	1	1989	DRY	6	ND	0.0002	ND	0.002	0.0008	0.0002	ND	0.0002	0.008	0.001
S3LR	2	1	1989	DRY	6	ND	0.0002	0.002	0.002	0.0009	0.0002	ND	0.0002	0.006	0.001
S3FD	2	1	1989	DRY	6	ND	0.0002	ND	0.002	0.0005	0.0002	ND	0.0002	0.010	0.001
S3	4	6	1989	DRY	7	ND	0.0002	0.002	0.002	ND	0.0002	0.0002	0.0002	0.010	0.001
S3FD	4	6	1989	DRY	7	ND	0.0002	ND	0.002	ND	0.0002	ND	0.0002	0.015	0.001
S3	4	20	1988	WET	1	0.0019	0.0002	0.11	0.001	ND	0.002	0.0006	0.0001	0.27	0.01
S3	11	23	1988	WET	2	0.006	0.0002	0.22	0.001	ND	0.0003	0.0002	0.0002	0.45	0.001
S3LR	11	23	1988	WET	2	0.002	0.0002	0.1	0.001	ND	0.0003	0.0002	0.0002	0.4	0.001
S3	1	23	1989	WET	3	ND	0.0002	0.006	0.002	ND	0.0002	ND	0.0002	0.19	0.001
S3	2	4	1989	WET	4	0.0004	0.0002	0.084	0.002	ND	0.0002	ND	0.0002	0.23	0.001
S3	2	9	1989	WET	5	ND	0.0002	0.11	0.002	ND	0.0002	ND	0.0002	0.35	0.001
S3	3	2	1989	WET	6	ND	0.0002	0.08	0.002	0.001	0.0002	0.0004	0.0002	0.019	0.001

Sample I.D.	Date Sampled Month	Day	Year	Sample Type	Sample Event	Mercury actual mg/l	D.L. mg/l	Nickel actual mg/l	D.L. mg/l	Selenium actual mg/l	D.L. mg/l	Silver actual mg/l	D.L. mg/l	Zinc actual mg/l	D.L. mg/l
STANDARD REPORTING OBJECTIVES							0.0002		0.001		0.0002		0.0001		0.001
S4	2	26	1988	DRY	1	ND	0.0002	ND	0.002	0.005	0.0002	0.0022	0.0002	0.016	0.001
S4	3	30	1988	DRY	2	ND	0.0002			ND	0.01	0.0033	0.0005	0.009	0.001
S4	5	11	1988	DRY	3	ND	0.0002			ND	0.002	0.0034	0.0002	0.023	0.002
S4LR	5	11	1988	DRY	3	ND	0.0002			ND	0.002	0.0033	0.0002	0.026	0.002
S4	8	25	1988	DRY	4	0.0023	0.0002			0.0018	0.0002	0.0018	0.0005	0.011	0.001
S4	12	12	1988	DRY	5	ND	0.0002			ND	0.0002	ND	0.0002	0.010	0.001
S4	2	1	1989	DRY	6	ND	0.0002	ND	0.002	0.0004	0.0002	ND	0.0002	0.012	0.001
S4	4	6	1989	DRY	7	ND	0.0002	0.005	0.002	0.001	0.0002	0.0002	0.0002	0.020	0.001
S4	4	20	1988	WET	1	0.0003	0.0002	0.046	0.001	ND	0.002	0.001	0.0001	0.14	0.01
S4	11	23	1988	WET	2	0.004	0.0002	0.24	0.001	ND	0.0003	0.0004	0.0002	0.61	0.001
S4FD	11	23	1988	WET	2	0.003	0.0002	0.1	0.001	ND	0.0003	ND	0.0002	0.25	0.001
S4	2	4	1989	WET	4	0.0005	0.0002	0.037	0.002	ND	0.0002	ND	0.0002	0.17	0.001
S4	2	9	1989	WET	5	ND	0.0002	0.035	0.002	ND	0.0002	ND	0.0002	0.18	0.001
S4	3	2	1989	WET	6	ND	0.0002	0.12	0.002	0.001	0.0002	0.0003	0.0002	0.036	0.001
S4	3	25	1989	WET	7	ND	0.0002	0.15	0.002	ND	0.0002	0.0020	0.0002	0.42	0.001
FB	8	25	1988	DRY	4	0.0003	0.0002			ND	0.0002	ND	0.0005	0.011	0.001
FB	12	12	1988	DRY	5	ND	0.0002			ND	0.0002	ND	0.0002	0.014	0.001
FB	2	1	1989	DRY	6	ND	0.0002	ND	0.002	ND	0.0002	ND	0.0002	0.010	0.001
FB	4	6	1989	DRY	7	ND	0.0002	ND	0.002	ND	0.0002	ND	0.0002	0.006	0.001
FB	11	23	1988	WET	2	0.0004	0.0002	ND	0.001	ND	0.0003	0.0002	0.0002	ND	0.001
FB	1	23	1989	WET	3	ND	0.0002	ND	0.002	ND	0.0002	ND	0.0002	0.01	0.001
FB	2	9	1989	WET	5	ND	0.0002	ND	0.002	ND	0.0002	ND	0.0002	ND	0.001
FB	3	2	1989	WET	6	ND	0.0002	0.06	0.002	ND	0.0002	ND	0.0002	0.018	0.001
FB	3	25	1989	WET	7	ND	0.0002	ND	0.002	ND	0.0002	ND	0.0002	0.003	0.001

Sample I.D.	Date Sampled			Sample Type	Sample Event	Arsenic actual mg/l	D.L. mg/l	Cadmium actual mg/l	D.L. mg/l	Chromium actual mg/l	D.L. mg/l	Hexav Cr actual mg/l	D.L. mg/l	Copper actual mg/l	D.L. mg/
	Month	Day	Year												
STANDARD REPORTING OBJECTIVES							0.001		0.0001		0.001				0.0
S4	2	26	1988	DRY	1	0.002	0.001	ND	0.0002	0.005	0.001			0.01	0.0
S4	3	30	1988	DRY	2									0.008	0.0
S4	5	11	1988	DRY	3									0.008	0.0
S4LR	5	11	1988	DRY	3									0.01	0.0
S4	8	25	1988	DRY	4									0.012	0.0
S4	12	12	1988	DRY	5							ND	0.01	0.003	0.0
S4	2	1	1989	DRY	6	ND	0.001	0.0006	0.0002	0.004	0.001	ND	0.01	0.001	0.0
S4	4	6	1989	DRY	7	0.002	0.001	ND	0.0002	0.003	0.001	ND	0.01	0.006	0.0
S4	4	20	1988	WET	1	0.003	0.001	0.0005	0.0002	0.018	0.001			0.042	0.0
S4	11	23	1988	WET	2	ND	0.001	0.004	0.0002	0.14	0.001			0.19	0.0
S4FD	11	23	1988	WET	2	ND	0.001	0.002	0.0002	0.065	0.001			0.072	0.0
S4	2	4	1989	WET	4	ND	0.001	0.0044	0.0002	0.021	0.001	ND	0.01	0.039	0.0
S4	2	9	1989	WET	5	ND	0.001	0.0035	0.0002	0.023	0.001	ND	0.01	0.035	0.0
S4	3	2	1989	WET	6	ND	0.001	0.0012	0.0002	0.027	0.001	ND	0.01	0.027	0.0
S4	3	25	1989	WET	7	0.008	0.001	0.0040	0.0002	0.073	0.001	ND	0.01	0.11	0.0
FB	8	25	1988	DRY	4									ND	0.0
FB	12	12	1988	DRY	5							ND	0.01	ND	0.0
FB	2	1	1989	DRY	6	ND	0.001	ND	0.0002	ND	0.001	ND	0.01	ND	0.0
FB	4	6	1989	DRY	7	ND	0.001	ND	0.0002	ND	0.001	ND	0.01	ND	0.0
FB	11	23	1988	WET	2	ND	0.001	0.0002	0.0002	0.002	0.001			ND	0.0
FB	1	23	1989	WET	3	ND	0.001	0.0019	0.0002	ND	0.001	ND	0.01	ND	0.0
FB	2	9	1989	WET	5	ND	0.001	ND	0.0002	ND	0.001	ND	0.01	0.004	0.0
FB	3	2	1989	WET	6	ND	0.001	ND	0.0002	0.052	0.001	ND	0.01	0.011	0.0
FB	3	25	1989	WET	7	0.001	0.001	ND	0.0002	0.001	0.001	ND	0.01	ND	0.0

D.1-2 Dissolved metals in water column

Sample I.D.	Date Sampled			Sample Type	Sample Event	Arsenic		Cadmium		Chromium		Hexav Cr		Copper	
	Month	Day	Year			actual mg/l	D.L. mg/l	actual mg/l	D.L. mg/l	actual mg/l	D.L. mg/l	actual mg/l	D.L. mg/l	actual mg/l	D.L. mg/l
STANDARD REPORTING OBJECTIVES															
L1	3	2	1989	WET	6	ND	0.001	0.005	0.0002	0.008	0.001	ND	0.01	0.010	0.001
L2	3	2	1989	WET	6	ND	0.001	0.001	0.0002	0.006	0.001	ND	0.01	0.013	0.001
L2	3	25	1989	WET	7	ND	0.001	ND	0.0002	0.006	0.001	ND	0.01	0.010	0.001
L3	3	2	1989	WET	6	ND	0.001	0.0003	0.0002	0.001	0.001	ND	0.01	0.009	0.001
L3	3	25	1989	WET	7	ND	0.001	ND	0.0002	0.001	0.001	ND	0.01	0.006	0.001
L4	3	25	1989	WET	7	ND	0.001	ND	0.0002	0.004	0.001	ND	0.01	0.002	0.001
L5	3	2	1989	WET	6	ND	0.001	0.0003	0.0002	0.001	0.001	ND	0.01	0.012	0.001
L5.FIELD.DUP	3	2	1989	WET	6	ND	0.001	ND	0.0002	0.001	0.001	ND	0.01	0.010	0.001
L5	3	25	1989	WET	7	ND	0.001	ND	0.0002	0.002	0.001	ND	0.01	0.007	0.001
L6	3	2	1989	WET	6	ND	0.001	ND	0.0002	0.001	0.001	ND	0.01	0.009	0.001
L6	3	25	1989	WET	7	ND	0.001	0.0003	0.0002	0.002	0.001	ND	0.01	0.009	0.001
L7	3	2	1989	WET	6	ND	0.001	ND	0.0002	0.001	0.001	ND	0.01	0.004	0.001
L7	3	25	1989	WET	7	ND	0.001	ND	0.0002	0.001	0.001	ND	0.01	0.009	0.001
S1	3	2	1989	WET	6	ND	0.001	0.0002	0.0002	0.001	0.001	ND	0.01	0.010	0.001
S1	3	25	1989	WET	7	ND	0.001	ND	0.0002	0.001	0.001	ND	0.01	0.007	0.001
S5	3	25	1989	WET	7	ND	0.001	ND	0.0002	0.001	0.001	ND	0.01	0.008	0.001
S2	3	2	1989	WET	6	ND	0.001	0.0003	0.0002	0.001	0.001	ND	0.01	0.011	0.001
S2	3	25	1989	WET	7	ND	0.001	ND	0.0002	0.001	0.001	ND	0.01	0.008	0.001
S3	3	2	1989	WET	6	ND	0.001	0.0002	0.0002	0.003	0.001	ND	0.01	0.006	0.001
S4	3	2	1989	WET	6	ND	0.001	0.0002	0.0002	0.001	0.001	ND	0.01	0.007	0.001
S4	3	25	1989	WET	7	ND	0.001	ND	0.0002	0.001	0.001	ND	0.01	0.006	0.001
FB	3	2	1989	WET	6	ND	0.001	ND	0.0002	0.001	0.001	ND	0.01	0.006	0.001
FB	3	25	1989	WET	7	ND	0.001	ND	0.0002	ND	0.001	ND	0.01	0.001	0.001

Sample I.D.	Date Sampled			Sample Type	Sample Event	Lead		Mercury		Nickel		Selenium		Silver	
	Month	Day	Year			actual mg/l	D.L. mg/l	actual mg/l	D.L. mg/l	actual mg/l	D.L. mg/l	actual mg/l	D.L. mg/l	actual mg/l	D.L. mg/l
STANDARD REPORTING OBJECTIVES															
L1	3	2	1989	WET	6	0.005	0.001	ND	0.0002	0.017	0.002	ND	0.0002	0.006	0.0002
L2	3	2	1989	WET	6	0.002	0.001	ND	0.0002	0.006	0.002	ND	0.0002	ND	0.0002
L2	3	25	1989	WET	7	0.003	0.001	ND	0.0002	0.008	0.002	ND	0.0002	0.0005	0.0002
L3	3	2	1989	WET	6	ND	0.001	ND	0.0002	ND	0.002	ND	0.0002	ND	0.0002
L3	3	25	1989	WET	7	ND	0.001	ND	0.0002	0.004	0.002	ND	0.0002	ND	0.0002
L4	3	25	1989	WET	7	ND	0.001	ND	0.0002	0.008	0.002	0.001	0.0002	0.002	0.0002
L5	3	2	1989	WET	6	ND	0.001	ND	0.0002	ND	0.002	ND	0.0002	ND	0.0002
L5.FIELD.DUP	3	2	1989	WET	6	ND	0.001	ND	0.0002	0.005	0.002	ND	0.0002	ND	0.0002
L5	3	25	1989	WET	7	0.002	0.001	ND	0.0002	0.005	0.002	ND	0.0002	ND	0.0002
L6	3	2	1989	WET	6	ND	0.001	ND	0.0002	0.004	0.002	ND	0.0002	ND	0.0002
L6	3	25	1989	WET	7	0.003	0.001	ND	0.0002	0.008	0.002	ND	0.0002	ND	0.0002
L7	3	2	1989	WET	6	ND	0.001	ND	0.0002	ND	0.002	ND	0.0002	ND	0.0002
L7	3	25	1989	WET	7	ND	0.001	ND	0.0002	0.006	0.002	ND	0.0002	0.0002	0.0002
S1	3	2	1989	WET	6	ND	0.001	ND	0.0002	ND	0.002	0.001	0.0002	ND	0.0002
S1	3	25	1989	WET	7	ND	0.001	ND	0.0002	0.005	0.002	ND	0.0002	ND	0.0002
S5	3	25	1989	WET	7	ND	0.001	ND	0.0002	0.005	0.002	ND	0.0002	ND	0.0002
S2	3	2	1989	WET	6	ND	0.001	ND	0.0002	ND	0.002	ND	0.0002	ND	0.0002
S2	3	25	1989	WET	7	ND	0.001	ND	0.0002	0.005	0.002	ND	0.0002	ND	0.0002
S3	3	2	1989	WET	6	ND	0.001	ND	0.0002	0.006	0.002	0.001	0.0002	0.0002	0.0002
S4	3	2	1989	WET	6	ND	0.001	ND	0.0002	0.008	0.002	0.001	0.0002	0.0002	0.0002
S4	3	25	1989	WET	7	ND	0.001	ND	0.0002	0.006	0.002	ND	0.0002	0.0004	0.0002
FB	3	2	1989	WET	6	ND	0.001	ND	0.0002	0.004	0.002	ND	0.0002	ND	0.0002
FB	3	25	1989	WET	7	ND	0.001	ND	0.0002	ND	0.002	ND	0.0002	ND	0.0002

Sample I.D.	Date Sampled Month	Day	Year	Sample Type	Sample Event	Zinc actual mg/l	Zinc D.L. mg/l
STANDARD REPORTING OBJECTIVES							
L1	3	2	1989	WET	6	0.3	0.001
L2	3	2	1989	WET	6	0.8	0.001
L2	3	25	1989	WET	7	0.20	0.001
L3	3	2	1989	WET	6	0.1	0.001
L3	3	25	1989	WET	7	0.10	0.001
L4	3	25	1989	WET	7	0.005	0.001
L5	3	2	1989	WET	6	0.1	0.001
L5.FIELD.DUP	3	2	1989	WET	6	0.09	0.001
L5	3	25	1989	WET	7	0.10	0.001
L6	3	2	1989	WET	6	0.1	0.001
L6	3	25	1989	WET	7	0.10	0.001
L7	3	2	1989	WET	6	0.003	0.001
L7	3	25	1989	WET	7	0.007	0.001
S1	3	2	1989	WET	6	0.1	0.001
S1	3	25	1989	WET	7	0.040	0.001
S5	3	25	1989	WET	7	0.040	0.001
S2	3	2	1989	WET	6	0.1	0.001
S2	3	25	1989	WET	7	0.040	0.001
S3	3	2	1989	WET	6	0.017	0.001
S4	3	2	1989	WET	6	ND	0.001
S4	3	25	1989	WET	7	0.016	0.001
FB	3	2	1989	WET	6	0.015	0.001
FB	3	25	1989	WET	7	0.015	0.001

D.1-3 Total metals in sediment

Sample I.D.	Date Sampled			Sample Type	Sample Event	Arsenic		Cadmium		Chromium		Copper		Lead	
	Month	Day	Year			actual mg/kg	D.L. mg/kg	actual mg/kg	D.L. mg/kg	actual mg/kg	D.L. mg/kg	actual mg/kg	D.L. mg/kg	actual mg/kg	D.L. mg/kg
STANDARD REPORTING OBJECTIVES							0.1		0.1		1		1		1
S1	3	30	1988	DRY	1	3.7	0.1	0.1	0.1	77	1	23	1	9	1
S1	5	11	1988	DRY	2	4.5	0.1	0.1	0.1	78	0.1	25	0.1	44	0.1
S1	8	22	1988	DRY	3		0.1		0.1		0.1	27	0.1	16	0.1
S1	12	12	1988	DRY	4							63	1	45	1
S2	3	30	1988	DRY	1	2.9	0.1	0.5	0.1	78	1	76	1	93	1
S2	5	11	1988	DRY	2	4.3	0.1	2	0.1	84	0.1	46	0.1	98	0.1
S2	8	22	1988	DRY	3		0.1		0.1		0.1	40	0.1	40	0.1
S2	12	12	1988	DRY	4							32	1	32	1
S3	3	30	1988	DRY	1	6.7	0.1	1.4	0.1	170	1	100	1	150	1
S3	5	11	1988	DRY	2	4.1	0.1	0.1	0.1	80	0.1	37	0.1	25	0.1
S3	8	22	1988	DRY	3		0.1		0.1		0.1	97	0.1	160	0.1
S3FD	8	22	1988	DRY	3		0.1		0.1		0.1	95	0.1	150	0.1
S3	12	12	1988	DRY	4							45	1	64	1
S3FD	12	12	1988	DRY	4							45	1	86	1
S3LR	12	12	1988	DRY	4							43	1	55	1
S4	3	30	1988	DRY	1	7.9	0.1	0.4	0.1	80	1	35	1	28	1
S4LR	3	30	1988	DRY	1	8.8	0.1	0.3	0.1	83	1	33	1	28	1
S4	5	11	1988	DRY	2	6.6	0.1	1.3	0.1	110	0.1	87	0.1	120	0.1
S4FD	5	11	1988	DRY	2	5.6	0.1	0.7	0.1	87	0.1	53	0.1	67	0.1
S4	8	22	1988	DRY	3		0.1		0.1		0.1	65	0.1	77	0.1
S4	12	12	1988	DRY	4							29	1	33	1

	Date Sampled					Mercury		Nickel		Selenium		Silver		Zinc	
Sample I.D.	Month	Day	Year	Sample Type	Sample Event	actual mg/kg	D.L. mg/kg	actual mg/kg	D.L. mg/kg	actual mg/kg	D.L. mg/kg	actual mg/kg	D.L. mg/kg	actual mg/kg	D.L. mg/kg
STANDARD REPORTING OBJECTIVES							0.1		1		0.1		0.1		1
S1	3	30	1988	DRY	1	0.1	0.1	49	1	ND	0.1	1	0.1	70	1
S1	5	11	1988	DRY	2	0.05	0.02	69	0.1	ND	0.2	0.7	0.1	84	1
S1	8	22	1988	DRY	3	ND	0.02	69	0.1	0.3	0.1	0.6	0.1	68	1
S1	12	12	1988	DRY	4	0.38	0.1			0.27	0.1	ND	0.1	180	1
S2	3	30	1988	DRY	1	0.2	0.1	41	1	3.3	0.1	1.3	0.1	150	1
S2	5	11	1988	DRY	2	0.14	0.02	76	0.1	0.2	0.2	0.9	0.1	100	1
S2	8	22	1988	DRY	3	ND	0.02	76	0.1	1	0.1	1.5	0.1	99	1
S2	12	12	1988	DRY	4	0.15	0.1			1.2	0.1	ND	0.1	110	1
S3	3	30	1988	DRY	1	4.1	0.1	160	1	1.4	0.1	2	0.1	290	1
S3	5	11	1988	DRY	2	0.74	0.02	97	0.1	ND	0.2	0.7	0.1	69	1
S3	8	22	1988	DRY	3	4.7	0.02	97	0.1	0.8	0.1	2	0.1	340	1
S3FD	8	22	1988	DRY	3	4.4	0.02	110	0.1	1	0.1	1.8	0.1	330	1
S3	12	12	1988	DRY	4	3.6	0.1			1	0.1	ND	0.1	160	1
S3FD	12	12	1988	DRY	4	2.6	0.1			1	0.1	ND	0.1	150	1
S3LR	12	12	1988	DRY	4	2.7	0.1			0.85	0.1	ND	0.1	140	1
S4	3	30	1988	DRY	1	0.1	0.1	85	1	0.59	0.1	1.2	0.1	100	1
S4LR	3	30	1988	DRY	1	0.2	0.1	82	1	0.49	0.1	1.1	0.1	110	1
S4	5	11	1988	DRY	2	0.49	0.02	140	0.1	0.5	0.2	1.9	0.1	360	1
S4FD	5	11	1988	DRY	2	0.23	0.02	110	0.1	0.3	0.2	1	0.1	210	1
S4	8	22	1988	DRY	3	0.17	0.02	140	0.1	0.4	0.1	1.3	0.1	190	1
S4	12	12	1988	DRY	4	0.45	0.1			0.58	0.1	ND	0.1	89	1

D.2 Conventional parameters

D.2-1 Conventional parameters in water column

	Date Sampled					TSS		NO3-N		NO2-N		NH3-N		TKN		PO4-P		pH
Sample I.D.	Month	Day	Year	Sample Type	Sample Event	actual mg/L	D.L. mg/L	actual mg/L	D.L. mg/L	actual mg/L	D.L. mg/L	actual mg/L	D.L. mg/L	actual mg/L	D.L. mg/L	actual mg/L	D.L. mg/L	
L1	4	20	1988	WET	1	23	1	1	0.1	0.02	0.01	0.2	0.1	2.8	0.1	0.3	0.1	7.5
L1	11	23	1988	WET	2	69	10	0.31	0.1	0.016	0.01	ND	1	1.1	1	0.23	0.1	
L1	2	4	1989	WET	4	72	1							4.3	1			
L1	2	9	1989	WET	5	82	1							2.7	1			
L1LR	2	9	1989	WET	5													
L1	3	2	1989	WET	6	40	1.0							3.0	1.0			
L1LR	3	2	1989	WET	6													
L2	4	20	1988	WET	1	78	1	0.7	0.1	0.05	0.01	0.6	0.1	2.2	0.1	0.8	0.1	7.5
L2	11	23	1988	WET	2	110	10	0.4	0.1	0.095	0.01	ND	1	1.7	1	0.56	0.1	
L2	2	4	1989	WET	4	64	1							2.6	1			
L2	2	9	1989	WET	5	130	1							1.9	1			
L2	3	2	1989	WET	6													
L2	3	2	1989	WET	6	130	1.0							ND	1.0			
L2	3	25	1989	WET	7	300	1.0											
L3	4	20	1988	WET	1	62	1	0.6	0.1	0.04	0.01	0.2	0.1	1.7	0.1	0.4	0.1	7.2
L3	11	23	1988	WET	2	19	10	0.65	0.1	0.049	0.01	ND	1	ND	1	0.15	0.1	
L3	2	4	1989	WET	4	40	1							5.5	1			
L3	2	9	1989	WET	5	62	1							2.4	1			
L3	3	2	1989	WET	6	56	1.0							ND	1.0			
L3	3	25	1989	WET	7	170	1.0											
L4	4	20	1988	WET	1													
L4	11	23	1988	WET	2													
L4	2	4	1989	WET	4	32	1							ND	1			
L4	2	9	1989	WET	5	84	1							1.1	1			
L4	3	2	1989	WET	6													
L4	3	25	1989	WET	7	80	1.0											
L5	4	20	1988	WET	1													
L5	11	23	1988	WET	2	110	10	0.7	0.1	0.028	0.01	ND	1	1.6	1	0.34	0.1	
L5	1	23	1989	WET	3	62	1.0							2.0	1.0			
L5	2	4	1989	WET	4	52	1							1.2	1			
L5LR	2	4	1989	WET	4													
L5	2	9	1989	WET	5	140	1							4.5	1			
L5	3	2	1989	WET	6	90	1.0							1.4	1.0			
L5FD	3	2	1989	WET	6	94	1.0							2.8	1.0			
L5	3	25	1989	WET	7	130	1.0											
L6	4	20	1988	WET	1													
L6	11	23	1988	WET	2	60	10	0.69	0.1	0.066	0.01	ND	1	1.8	1	0.24	0.1	
L6	2	9	1989	WET	5	54	1							ND	1			
L6	3	2	1989	WET	6	110	1.0							ND	1.0			
L6	3	25	1989	WET	7	92	1.0											

Sample I.D.	Date Sampled			Sample Type	Sample Event	TSS		NO3-N		NO2-N		NH3-N		TKN		PO4-P		pH
	Month	Day	Year			actual mg/L	D.L. mg/L	actual mg/L	D.L. mg/L	actual mg/L	D.L. mg/L	actual mg/L	D.L. mg/L	actual mg/L	D.L. mg/L	actual mg/L	D.L. mg/L	
L7	4	20	1988	WET	1													
L7	11	23	1988	WET	2	36	10	0.18	0.1	ND	0.01	ND	1	ND	1	0.19	0.1	
L7	2	4	1989	WET	4	26	1							1.5	1			
L7	2	9	1989	WET	5	12	1							ND	1			
L7	3	2	1989	WET	6	22	1.0							ND	1.0			
L7	3	25	1989	WET	7	420	1.0											
R1	2	27	1988	RES	1	24	10	0.1	0.1	0.006	0.005	ND	1	ND	1	ND	0.1	8
R2	2	26	1988	RES	1	11	10	0.8	0.1	0.009	0.005	ND	1	1	1	ND	0.1	8
R3	2	27	1988	RES	1	ND	10	0.2	0.1	0.005	0.005	ND	1	ND	1	ND	0.1	8.2
R4	2	27	1988	RES	1	84	10	0.1	0.1	0.006	0.005	ND	1	ND	1	0.2	0.1	8
R5	2	27	1988	RES	1	ND	10	ND	0.1	0.007	0.005	ND	1	1	1	0.1	0.1	8.5
R6	2	27	1988	RES	1	ND	10	0.2	0.1	0.006	0.005	ND	1	1	1	ND	0.1	8.6
S1	2	26	1988	DRY	1	ND	10	ND	0.1	ND	0.005	ND	1	2	1	0.1	0.1	8.2
S1	3	30	1988	DRY	2	3	1							1.1	0.1			9
S1	5	11	1988	DRY	3	1	0.1							1.4	0.1			8.7
S1	12	12	1988	DRY	5	ND	10							ND	1.0			
S1	2	1	1989	DRY	6	ND	10							ND	1			
S1	4	6	1989	DRY	7	1.6	1.0							ND	1.0			
S1	4	20	1988	WET	1													
S1	11	23	1988	WET	2	360	10	0.5	0.1	0.032	0.01	ND	1	2	1	0.56	0.1	
S1	1	23	1989	WET	3	5.5	1.0							ND	1.0			
S1	2	4	1989	WET	4	34	1							2	1			
S1	2	9	1989	WET	5	76	1							ND	1			
S1FD	2	9	1989	WET	5	50	1							1.8	1			
S1	3	2	1989	WET	6	180	1.0							1.4	1.0			
S1	3	25	1989	WET	7	190	1.0											
S1LR	3	25	1989	WET	7													
S1FD	3	25	1989	WET	7	220	1.0											

						TSS		NO3-N		NO2-N		NH3-N		TKN		PO4-P		pH
Sample I.D.	Date Sampled Month	Day	Year	Sample Type	Sample Event	actual mg/L	D.L. mg/L	actual mg/L	D.L. mg/L	actual mg/L	D.L. mg/L	actual mg/L	D.L. mg/L	actual mg/L	D.L. mg/L	actual mg/L	D.L. mg/L	
S2	2	26	1988	DRY	1	ND	10	2.5	0.1	0.012	0.005	ND	1	1	1	ND	0.1	8.8
S2	3	30	1988	DRY	2	5	1							0.6	0.1			8.7
S2	5	11	1988	DRY	3	0.5	0.1							4.8	0.1			8.4
S2	12	12	1988	DRY	5	ND	10							ND	1.0			
S2	2	1	1989	DRY	6	ND	10							ND	1			
S2	4	6	1989	DRY	7	ND	1.0							ND	1.0			
S2	4	20	1988	WET	1													
S2	11	23	1988	WET	2	990	10	0.51	0.1	0.051	0.01	ND	1	2.5	1	0.9	0.1	
S2	1	23	1989	WET	3	40	1.0							1.7	1.0			
S2FD	1	23	1989	WET	3	18	1.0							1.5	1.0			
S2	2	4	1989	WET	4	36	1							1.8	1			
S2FD	2	4	1989	WET	4	46	1							1.7	1			
S2	2	9	1989	WET	5	170	1							1.6	1			
S2	3	2	1989	WET	6	200	1.0							1.7	1.0			
S2	3	25	1989	WET	7	210	1.0											
S3	2	26	1988	DRY	1	ND	10	2.4	0.1	0.006	0.005	ND	1	ND	1	0.1	0.1	8.4
S3	3	30	1988	DRY	2	11	1							1.4	0.1			8.5
S3	5	11	1988	DRY	3	7	0.1							1.4	0.1			8.4
S3	8	22	1988	DRY	4	8.5	1	2	0.1	ND	0.1			1	0.5			
S3FD	8	22	1988	DRY	4	5.5	1	1.8	0.1	ND	0.1			3	0.5			
S3FD	8	22	1988	DRY	4													
S3	12	12	1988	DRY	5	ND	10							ND	1.0			
S3FD	12	12	1988	DRY	5	ND	10							ND	1.0			
S3	2	1	1989	DRY	6	ND	10							ND	1			
S3LR	2	1	1989	DRY	6	ND	10							ND	1			
S3FD	2	1	1989	DRY	6	ND	10							ND	1			
S3	4	6	1989	DRY	7	2.4	1.0							ND	1.0			
S3LR	4	6	1989	DRY	7													
S3FD	4	6	1989	DRY	7	2.8	1.0							ND	1.0			
S3	4	20	1988	WET	1													
S3	11	23	1988	WET	2	1700	10	0.62	0.1	0.025	0.01	ND	1	5	1	1.15	0.1	
S3FD	11	23	1988	WET	2													
S3LR	11	23	1988	WET	2	1700	10	0.65	0.1	0.024	0.01	ND	1	5.3	1	1.04	0.1	
S3	1	23	1989	WET	3	290	1.0							1.9	1.0			
S3FD	1	23	1989	WET	3													
S3LR	1	23	1989	WET	3													
S3	2	4	1989	WET	4	190	1							1.9	1			
S3	2	9	1989	WET	5	270	1							1.4	1			
S3	3	2	1989	WET	6	64	1.0							1.5	1.0			

Sample I.D.	Date Sampled Month	Day	Year	Sample Type	Sample Event	TSS actual mg/L	TSS D.L. mg/L	NO3-N actual mg/L	NO3-N D.L. mg/L	NO2-N actual mg/L	NO2-N D.L. mg/L	NH3-N actual mg/L	NH3-N D.L. mg/L	TKN actual mg/L	TKN D.L. mg/L	PO4-P actual mg/L	PO4-P D.L. mg/L	pH
S4	2	26	1988	DRY	1	25	10	3.5	0.1	0.018	0.005	ND	1	2	1	0.1	0.1	8.4
S4	3	30	1988	DRY	2	20	1							2.2	0.1			8.1
S4	5	11	1988	DRY	3	30	0.1							1.7	0.1			7.5
S4FD	5	11	1988	DRY	3	39	0.1							1.7	0.1			7.7
S4	8	22	1988	DRY	4	19	1	2	0.1	ND	0.1			5	0.5			
S4	12	12	1988	DRY	5	13	10							ND	1.0			
S4	2	1	1989	DRY	6													
S4	2	1	1989	DRY	6	52	10							1.2	1			
S4	4	6	1989	DRY	7	5.2	1.0							ND	1.0			
S4D	3	30	1988	DRY	2	22	1							2.2	0.1			8.1
S4	4	20	1988	WET	1	250	1	1.2	0.1	0.03	0.01	0.2	0.1	2.5	0.1	0.9	0.1	7.6
S4	11	23	1988	WET	2	430	10	0.57	0.1	0.045	0.01	ND	1	1.8	1	0.55	0.1	
S4FD	11	23	1988	WET	2	1200	10	0.62	0.1	0.032	0.01	ND	1	1.6	1	0.86	0.1	
S4	1	23	1989	WET	3													
S4	2	4	1989	WET	4	120	1							1.2	1			
S4	2	9	1989	WET	5	150	1							1.1	1			
S4	3	2	1989	WET	6	130	1.0							ND	1.0			
S4	3	25	1989	WET	7	370	1.0											
FB	8	22	1988	DRY	4	2.5	1	ND	0.1	ND	0.1			ND	0.5			
FB	8	22	1988	DRY	4													
FB	12	12	1988	DRY	5													
FB	12	12	1988	DRY	5	ND	10							ND	1.0			
FB	2	1	1989	DRY	6													
FB	2	1	1989	DRY	6	ND	10							ND	1			
FB	4	6	1989	DRY	7													
FB	4	6	1989	DRY	7	ND	1.0							ND	1.0			
FB	11	23	1988	WET	2													
FB	11	23	1988	WET	2													
FB	11	23	1988	WET	2	IS	10	ND	0.1	ND	0.01	ND	1	ND	1	IS	0.1	
FB	1	23	1989	WET	3													
FB	1	23	1989	WET	3	ND	1.0							ND	1.0			
FB	2	9	1989	WET	5													
FB	2	9	1989	WET	5	NA	1							ND	1			
FB	3	2	1989	WET	6													
FB	3	2	1989	WET	6		1.0							ND	1.0			
FB	3	25	1989	WET	7		1.0											

Sample I.D.	Date Sampled			Sample Type	Sample Event	TOC		BOD		COD		Total Coliform MPN per 100ml of sample	D.L. MPN/100	Fecal Coliform MPN per 100ml of sample	D.L. MPN/100
	Month	Day	Year			actual mg/L	D.L. mg/L	actual mg/L	D.L. mg/L	actual mg/L	D.L. mg/L				
L1	4	20	1988	WET	1	13	1	5				2300	2	2300	2
L1	11	23	1988	WET	2	6.8	0.1	9	1			110000	3	24000	3
L1	2	4	1989	WET	4	18	1	5.3	1						
L1	2	9	1989	WET	5	44	1	10	1			110000	3	15000	3
L1LR	2	9	1989	WET	5	44	1								
L1	3	2	1989	WET	6	260	1	35	1.0			9300	3	150	3
L1LR	3	2	1989	WET	6	260	1								
L2	4	20	1988	WET	1	23	1	13				7900	2	2300	2
L2	11	23	1988	WET	2	9.9	0.1	10	1			4600	3	2400	3
L2	2	4	1989	WET	4	11	1	3.6	1						
L2	2	9	1989	WET	5	13	1	8.4	1			4600	3	2400	3
L2	3	2	1989	WET	6							7500	3	93	3
L2	3	2	1989	WET	6			16	1.0						
L2	3	25	1989	WET	7	8.3	1	13	1.0						
L3	4	20	1988	WET	1	16	1	7				350000	2	7900	2
L3	11	23	1988	WET	2	9.2	0.1	7	1			46000	3	11000	3
L3	2	4	1989	WET	4	9.5	1	4.3	1						
L3	2	9	1989	WET	5	8.2	1	5.9	1			11000	3	4600	3
L3	3	2	1989	WET	6	12	1	12	1.0			24000	3	930	3
L3	3	25	1989	WET	7	8.9	1	14	1.0						
L4	4	20	1988	WET	1			7				24000	2	4900	2
L4	11	23	1988	WET	2							>240000	3	110000	3
L4	2	4	1989	WET	4	9.7	1	3.1	1						
L4	2	9	1989	WET	5	8.7	1	4.2	1			24000	3	2400	3
L4	3	2	1989	WET	6							15000	3	2400	3
L4	3	25	1989	WET	7	9.4	1	11	1.0						
L5	4	20	1988	WET	1							170000	2	4900	2
L5	11	23	1988	WET	2	12	0.1	10	1			4600	3	400	3
L5	1	23	1989	WET	3	21	1	14	1			24000	3	2400	3
L5	2	4	1989	WET	4	11	1	4.4	1						
L5LR	2	4	1989	WET	4	11	1								
L5	2	9	1989	WET	5	7.7	1	3.7	1			46000	3	2400	3
L5	3	2	1989	WET	6	12	1	13	1.0			46000	3	2400	3
L5FD	3	2	1989	WET	6	12	1	15	1.0			110000	3	4300	3
L5	3	25	1989	WET	7	6.7	1	12	1.0						
L6	4	20	1988	WET	1	17	1					70000	2	500	2
L6	11	23	1988	WET	2	14	0.1	13	1			46000	3	1500	3
L6	2	9	1989	WET	5	6.5	1	4.2	1			46000	3	15000	3
L6	3	2	1989	WET	6	18	1	25	1.0			2100	3	240	3
L6	3	25	1989	WET	7	6.3	1	10	1.0						

Sample I.D.	Date Sampled Month	Day	Year	Sample Type	Sample Event	TOC actual mg/L	D.L. mg/L	BOD actual mg/L	D.L. mg/L	COD actual mg/L	D.L. mg/L	Total Coliform MPN per 100ml of sample	D.L. MPN/100	Fecal Coliform MPN per 100ml of sample	D.L. MPN/100
L7	4	20	1988	WET	1							17000	2	800	2
L7	11	23	1988	WET	2	7.1	0.1	5	1			110000	3	11000	3
L7	2	4	1989	WET	4	4.6	1	2.1	1						
L7	2	9	1989	WET	5	3.1	1	3.1	1			750	3	75	3
L7	3	2	1989	WET	6	3.7	1	7.2	1.0			93	3	93	3
L7	3	25	1989	WET	7	6.1	1	7.3	1.0						
R1	2	27	1988	RES	1	5	1			31	5	7.8	2	<2	2
R2	2	26	1988	RES	1	4	1			31	5	49	2	33	2
R3	2	27	1988	RES	1	4	1			16	5	2	2	<2	2
R4	2	27	1988	RES	1	4	1			16	5	7.8	2	4.5	2
R5	2	27	1988	RES	1	7	1			16	5	540	2	13	2
R6	2	27	1988	RES	1	5	1			ND	5	2	2	<2	2
S1	2	26	1988	DRY	1	9	1			63	5	2400	2	2400	2
S1	3	30	1988	DRY	2			8	1			4900	2	2300	2
S1	5	11	1988	DRY	3	0.4	1	1	1			130000	2	8000	2
S1	12	12	1988	DRY	5			3	1			>2400	3	>2400	3
S1	2	1	1989	DRY	6	3.0	1	3.6	1			4600	3	43	3
S1	4	6	1989	DRY	7	3.8	1	1.5	1.0			11000	3	1500	3
S1	4	20	1988	WET	1							350000	2	3300	2
S1	11	23	1988	WET	2	10	0.1	13	1			>240000	3	110000	3
S1	1	23	1989	WET	3	9.0	1	5.8	1			110000	3	46000	3
S1	2	4	1989	WET	4	14	1	2.8	1						
S1	2	9	1989	WET	5	12	1	6.7	1			>240000	3	>240000	3
S1FD	2	9	1989	WET	5	12	1	4.0	1			>240000	3	11000	3
S1	3	2	1989	WET	6	14	1	21	1.0			46000	3	24000	3
S1	3	25	1989	WET	7	8.3	1	10	1.0						
S1LR	3	25	1989	WET	7	8.4	1								
S1FD	3	25	1989	WET	7	8.1	1	9.2	1.0						

Sample	Date Sampled			Sample	Sample	TOC		BOD		COD		Total Coliform MPN per 100ml		Fecal Coliform MPN per 100ml	
I.D.	Month	Day	Year	Type	Event	actual mg/L	D.L. mg/L	actual mg/L	D.L. mg/L	actual mg/L	D.L. mg/L	of sample	D.L. MPN/100	of sample	D.L. MPN/100
S2	2	26	1988	DRY	1	5	1			31	5	35000	2	4600	2
S2	3	30	1988	DRY	2			4	1			1300	2	1300	2
S2	5	11	1988	DRY	3	5.3	1	ND	1			30000	2	2000	2
S2	12	12	1988	DRY	5			3	1			>2400	3	>2400	3
S2	2	1	1989	DRY	6	2.1	1	2.7	1			11000	3	93	3
S2	4	6	1989	DRY	7	1.9	1	2.5	1.0			2400	3	460	3
S2	4	20	1988	WET	1	13	1					54000	2	7000	2
S2	11	23	1988	WET	2	14	0.1	45	1			>240000	3	<240000	3
S2	1	23	1989	WET	3	19	1	13	1			24000	3	11000	3
S2FD	1	23	1989	WET	3	19	1	12	1						
S2	2	4	1989	WET	4	14	1	3.3	1						
S2FD	2	4	1989	WET	4	11	1	4.1	1						
S2	2	9	1989	WET	5	10	1	7.3	1			>240000	3	11000	3
S2	3	2	1989	WET	6	14	1	21	1.0			15000	3	4600	3
S2	3	25	1989	WET	7	7.3	1	8.4	1.0						
S3	2	26	1988	DRY	1	2	1			47	5	5400	2	2400	2
S3	3	30	1988	DRY	2			6	1			7900	2	4900	2
S3	5	11	1988	DRY	3	6.4	1	2	1			110000	2	2000	2
S3	8	22	1988	DRY	4			7	1			>2400	2	70	2
S3FD	8	22	1988	DRY	4			5	1						
S3FD	8	22	1988	DRY	4							>2400	2	70	2
S3	12	12	1988	DRY	5			ND	1			>2400	3	1100	3
S3FD	12	12	1988	DRY	5			2	1			>2400	3	460	3
S3	2	1	1989	DRY	6	1.7	1	2.6	1			24000	3	43	3
S3LR	2	1	1989	DRY	6	1.6	1	2.4	1						
S3FD	2	1	1989	DRY	6	1.7	1	1.9	1			11000	3	23	3
S3	4	6	1989	DRY	7	2.3	1	1.9	1.0			4600	3	1100	3
S3LR	4	6	1989	DRY	7	2.3	1								
S3FD	4	6	1989	DRY	7	2.4	1	1.8	1.0			2400	3	460	3
S3	4	20	1988	WET	1	13	1					240000	2	17000	2
S3	11	23	1988	WET	2	23	0.1	4	1			>240000	3	<240000	3
S3FD	11	23	1988	WET	2	9	0.1					>240000	3	46000	3
S3LR	11	23	1988	WET	2	8.4	0.1	IS	1						
S3	1	23	1989	WET	3	20	1	12	1			24000	3	4600	3
S3FD	1	23	1989	WET	3							110000	3	24000	3
S3LR	1	23	1989	WET	3	15	1								
S3	2	4	1989	WET	4	8.9	1	2.8	1						
S3	2	9	1989	WET	5	8.6	1	7.9	1			24000	3	4600	3
S3	3	2	1989	WET	6			12	1.0			46000	3	46000	3

Sample I.D.	Date Sampled Month	Day	Year	Sample Type	Sample Event	TOC actual mg/L	D.L. mg/L	BOD actual mg/L	D.L. mg/L	COD actual mg/L	D.L. mg/L	Total Coliform MPN per 100ml of sample	D.L. MPN/100	Fecal Coliform MPN per 100ml of sample	D.L. MPN/100
S4	2	26	1988	DRY	1	5	1			16	5	2400	2	920	2
S4	3	30	1988	DRY	2			>15	1			24000	2	24000	2
S4	5	11	1988	DRY	3	33	1	6	1			900000	2	4000	2
S4FD	5	11	1988	DRY	3	22	1	6	1			>1600000	2	7000	2
S4	8	22	1988	DRY	4			9	1			>2400	2	70	2
S4	12	12	1988	DRY	5			ND	1			>2400	3	43	3
S4	2	1	1989	DRY	6							4600	3	93	3
S4	2	1	1989	DRY	6	5.3	1	1.9	1						
S4	4	6	1989	DRY	7	5.5	1	1.4	1.0			11000	3	2400	3
S4D	3	30	1988	DRY	2			>15	1						
S4	4	20	1988	WET	1	12						54000	2	17000	2
S4	11	23	1988	WET	2	8.9	0.1	12	1			>240000	3	110000	3
S4FD	11	23	1988	WET	2			20	1						
S4	1	23	1989	WET	3							>240000	3	>240000	3
S4	2	4	1989	WET	4	9.8	1	2.1	1						
S4	2	9	1989	WET	5	9.8	1	6.4	1			110000	3	15000	3
S4	3	2	1989	WET	6	13	1	15	1.0			110000	3	110000	3
S4	3	25	1989	WET	7	7.4	1	12	1.0						
FB	8	22	1988	DRY	4			8	1						
FB	8	22	1988	DRY	4							ND	2	ND	2
FB	12	12	1988	DRY	5							<3	3	<3	3
FB	12	12	1988	DRY	5			1	1						
FB	2	1	1989	DRY	6							ND	3	ND	3
FB	2	1	1989	DRY	6			ND	1						
FB	4	6	1989	DRY	7							ND	3	ND	3
FB	4	6	1989	DRY	7			ND	1.0						
FB	11	23	1988	WET	2		0.1								
FB	11	23	1988	WET	2							<3	3	<3	3
FB	11	23	1988	WET	2			IS	1						
FB	1	23	1989	WET	3							<3	3	<3	3
FB	1	23	1989	WET	3			ND	1						
FB	2	9	1989	WET	5							ND	3	ND	3
FB	2	9	1989	WET	5			ND	1						
FB	3	2	1989	WET	6							ND	3	ND	3
FB	3	2	1989	WET	6				1.0						
FB	3	25	1989	WET	7				1.0						

Sample I.D.	Date Sampled Month	Day	Year	Sample Type	Sample Event	Fecal Strep MPN per 100ml of sample	D.L. MPN/100	Hardness actual mg/L	D.L. mg/L	Turbidity actual NTU	D.L. NTU
L1	4	20	1988	WET	1						
L1	11	23	1988	WET	2			31	1	39	
L1	2	4	1989	WET	4			32	1	170	1
L1	2	9	1989	WET	5						
L1LR	2	9	1989	WET	5			36	1	82	1
L1	3	2	1989	WET	6			88	1.0	60	1.0
L1LR	3	2	1989	WET	6						
L2	4	20	1988	WET	1						
L2	11	23	1988	WET	2			47	1	77	
L2	2	4	1989	WET	4			42	1	170	1
L2	2	9	1989	WET	5			33	1	120	1
L2	3	2	1989	WET	6						
L2	3	2	1989	WET	6			47	1.0	140	1.0
L2	3	25	1989	WET	7			35	1.0	140	1.0
L3	4	20	1988	WET	1						
L3	11	23	1988	WET	2			33	1	21	
L3	2	4	1989	WET	4			32	1	66	1
L3	2	9	1989	WET	5			26	1	38	1
L3	3	2	1989	WET	6			25	1.0	51	1.0
L3	3	25	1989	WET	7			26	1.0	50	1.0
L4	4	20	1988	WET	1						
L4	11	23	1988	WET	2						
L4	2	4	1989	WET	4			530	1	37	1
L4	2	9	1989	WET	5			470	1	66	1
L4	3	2	1989	WET	6						
L4	3	25	1989	WET	7			550	1.0	64	1.0
L5	4	20	1988	WET	1						
L5	11	23	1988	WET	2			79	1	69	
L5	1	23	1989	WET	3	2400	3	51	1.0	59	1.0
L5	2	4	1989	WET	4			45	1	73	1
L5LR	2	4	1989	WET	4						
L5	2	9	1989	WET	5			41	1	110	1
L5	3	2	1989	WET	6			35	1.0	83	1.0
L5FD	3	2	1989	WET	6			59	1.0	69	1.0
L5	3	25	1989	WET	7			36	1.0	79	1.0
L6	4	20	1988	WET	1						
L6	11	23	1988	WET	2			56	1	36	
L6	2	9	1989	WET	5			25	1	30	1
L6	3	2	1989	WET	6			35	1.0	66	1.0
L6	3	25	1989	WET	7			37	1.0	100	1.0

Sample I.D.	Date Sampled Month	Day	Year	Sample Type	Sample Event	Fecal Strep MPN per 100ml of sample	D.L. MPN/100	Hardness actual mg/L	D.L. mg/L	Turbidity actual NTU	D.L. NTU
L7	4	20	1988	WET	1						
L7	11	23	1988	WET	2			260	1	25	
L7	2	4	1989	WET	4			250	1	39	1
L7	2	9	1989	WET	5			250	1	11	1
L7	3	2	1989	WET	6			250	1.0	19	1.0
L7	3	25	1989	WET	7			170	1.0	360	1.0
R1	2	27	1988	RES	1						
R2	2	26	1988	RES	1						
R3	2	27	1988	RES	1						
R4	2	27	1988	RES	1						
R5	2	27	1988	RES	1						
R6	2	27	1988	RES	1						
S1	2	26	1988	DRY	1						
S1	3	30	1988	DRY	2						
S1	5	11	1988	DRY	3						
S1	12	12	1988	DRY	5			230	1.0	4	1.0
S1	2	1	1989	DRY	6			190	1	5.2	1
S1	4	6	1989	DRY	7			220	1.0	1.8	1.0
S1	4	20	1988	WET	1						
S1	11	23	1988	WET	2			110	1	240	
S1	1	23	1989	WET	3	4660	3	240	1.0	5.1	1.0
S1	2	4	1989	WET	4			110	1	69	1
S1	2	9	1989	WET	5			60	1	69	1
S1FD	2	9	1989	WET	5			50	1	95	1
S1	3	2	1989	WET	6			76	1.0	120	1.0
S1	3	25	1989	WET	7			48	1.0	97	1.0
S1LR	3	25	1989	WET	7						
S1FD	3	25	1989	WET	7			64	1.0	120	1.0

Sample I.D.	Date Sampled Month	Day	Year	Sample Type	Sample Event	Fecal Strep MPN per 100ml of sample	D.L. MPN/100	Hardness actual mg/L	D.L. mg/L	Turbidity actual NTU	D.L. NTU
======	=====	===	=====	======	=====	=======	========	======	=====	=====	=====
S2	2	26	1988	DRY	1						
S2	3	30	1988	DRY	2						
S2	5	11	1988	DRY	3						
S2	12	12	1988	DRY	5			500	1.0	3	1.0
S2	2	1	1989	DRY	6			530	1	2.5	1
S2	4	6	1989	DRY	7			500	1.0	3.2	1.0
S2	4	20	1988	WET	1						
S2	11	23	1988	WET	2			330	1	480	
S2	1	23	1989	WET	3	1100	3	120	1.0	39	1.0
S2FD	1	23	1989	WET	3			86	1.0	27	1.0
S2	2	4	1989	WET	4			100	1	83	1
S2FD	2	4	1989	WET	4			47	1	87	1
S2	2	9	1989	WET	5			76	1	79	1
S2	3	2	1989	WET	6			88	1.0	110	1.0
S2	3	25	1989	WET	7			77	1.0	120	1.0
S3	2	26	1988	DRY	1						
S3	3	30	1988	DRY	2						
S3	5	11	1988	DRY	3						
S3	8	22	1988	DRY	4						
S3FD	8	22	1988	DRY	4						
S3FD	8	22	1988	DRY	4						
S3	12	12	1988	DRY	5			340	1.0	6	1.0
S3FD	12	12	1988	DRY	5			320	1.0	5	1.0
S3	2	1	1989	DRY	6			360	1	4.6	1
S3LR	2	1	1989	DRY	6			370	1	4.8	1
S3FD	2	1	1989	DRY	6			360	1	3.0	1
S3	4	6	1989	DRY	7			290	1.0	4.9	1.0
S3LR	4	6	1989	DRY	7						
S3FD	4	6	1989	DRY	7			300	1.0	3.5	1.0
S3	4	20	1988	WET	1						
S3	11	23	1988	WET	2			180	1	910	
S3FD	11	23	1988	WET	2						
S3LR	11	23	1988	WET	2			180	1	890	
S3	1	23	1989	WET	3			130	1.0	200	1.0
S3FD	1	23	1989	WET	3	4600	3				
S3LR	1	23	1989	WET	3						
S3	2	4	1989	WET	4			130	1	180	1
S3	2	9	1989	WET	5			140	1	150	1
S3	3	2	1989	WET	6			300	1.0	34	1.0

Sample I.D.	Date Sampled			Sample Type	Sample Event	Fecal Strep MPN per 100ml of sample		Hardness		Turbidity	
	Month	Day	Year				D.L. MPN/100	actual mg/L	D.L. mg/L	actual NTU	D.L. NTU
S4	2	26	1988	DRY	1						
S4	3	30	1988	DRY	2						
S4	5	11	1988	DRY	3						
S4FD	5	11	1988	DRY	3						
S4	8	22	1988	DRY	4						
S4	12	12	1988	DRY	5			460	1.0	15	1.0
S4	2	1	1989	DRY	6						
S4	2	1	1989	DRY	6			420	1	36	1
S4	4	6	1989	DRY	7			420	1.0	7.9	1.0
S4D	3	30	1988	DRY	2						
S4	4	20	1988	WET	1						
S4	11	23	1988	WET	2			230	1	380	
S4FD	11	23	1988	WET	2			150	1	650	
S4	1	23	1989	WET	3	>240000	3				
S4	2	4	1989	WET	4			160	1	120	1
S4	2	9	1989	WET	5			140	1	100	1
S4	3	2	1989	WET	6			140	1.0	86	1.0
S4	3	25	1989	WET	7			200	1.0	220	1.0
FB	8	22	1988	DRY	4						
FB	8	22	1988	DRY	4						
FB	12	12	1988	DRY	5						
FB	12	12	1988	DRY	5			ND	1.0	ND	1.0
FB	2	1	1989	DRY	6						
FB	2	1	1989	DRY	6			ND	1	ND	1
FB	4	6	1989	DRY	7						
FB	4	6	1989	DRY	7			ND	1.0	ND	1.0
FB	11	23	1988	WET	2						
FB	11	23	1988	WET	2						
FB	11	23	1988	WET	2			ND	1	IS	
FB	1	23	1989	WET	3	<3	3				
FB	1	23	1989	WET	3			ND	1.0	ND	1.0
FB	2	9	1989	WET	5						
FB	2	9	1989	WET	5			ND	1	ND	1
FB	3	2	1989	WET	6						
FB	3	2	1989	WET	6				1.0		1.0
FB	3	25	1989	WET	7				1.0		1.0

D.2-2 Conventional parameters in sediment

	Date Sampled					PARTICLE SIZE										
						% SAND	% SILT	% CLAY	NH3-N		TKN		TOC		BOD	
Sample I.D.	Month	Day	Year	Sample Type	Sample Event	0-4 PHI %	5-8 PHI %	=<9 PHI %	actual mg/kg	D.L. mg/kg	actual mg/kg	D.L. mg/kg	actual mg/kg	D.L. mg/kg	actual mg/kg	D.L. mg/kg
STANDARD LIMITS										1		1		100		25
S1	3	30	1988	DRY	1				82	1	210	1	ND	100		
S1	8	22	1988	DRY	3	76.9	9.3	0								
S1	12	12	1988	DRY	4	94.1	5.1	0.8								
S2	3	30	1988	DRY	1				130	1	830	1	16500	100		
S2	8	22	1988	DRY	3	83.3	11.4	1.1								
S2	12	12	1988	DRY	4	81.7	16	2.3								
S3	3	30	1988	DRY	1				150	1	920	1	33700	100		
S3	8	22	1988	DRY	3	26.4	64.3	9.3								
S3	12	12	1988	DRY	4	90.1	8.4	1.3								
S3LR	12	12	1988	DRY	4	94	4.4	1.7								
S4	3	30	1988	DRY	1				110	1	690	1	11400	100		
S4LR	3	30	1988	DRY	1				115	1	720	1	11100	100		
S4	8	22	1988	DRY	3	67.1	26	6.9								
S4FD	8	22	1988	DRY	3	22.3	68.1	9.7								
S4	12	12	1988	DRY	4	84.5	14	1.4								
S4FD	12	12	1988	DRY	4	89.5	8.9	1.5								

D.3 Organochlorine pesticides

ORGANOCHLORINE PESTICIDES

Abbreviated Name	Actual Name
6CL-CHX-A	Alpha-BHC (hexachlorocyclohexane
6CL-CHX-B	Beta-BHC (hexachlorocyclohexane)
6CL-CHX-D	Delta-BHC (hexachlorocyclohexane)
6CL-CHX-G	Gamma-BHC (hexachlorocyclohexane)
G-CHLORDANE	Gamma-chlordane
ENDOSULFAN-A	Endosulfan I
ENDOSULFAN-B	Endosulfan II
ENDOSULFAN-S	Endosulfan sulfate
ENDRIN-ALD	Endrin aldehyde
HEPCL EPOX	Heptachlor epoxide
METHOXYCL	Methoxychlor
tPCB	Total polychlorinated biphenyls
DDD	4,4'-DDD
DDE	4,4'-DDE
DDT	4,4'-DDT

D.3-1 Organochlorine pesticides in water column

	Date Sampled					ALDRIN		6CL-CHX-A		6CL-CHX-B		6CL-CHX-D		6CL-CHX-G		G-CHLORDANE	
Sample I.D.	Month	Day	Year	Sample Type	Sample Event	actual ug/l	D.L. ug/l	actual ug/l	D.L. ug/l	actual ug/l	D.L. ug/l	actual ug/l	D.L. ug/l	actual ug/l	D.L. ug/l	actual ug/l	D.L. ug/l
STANDARD REPORTING OBJECTIVES							0.05		0.05		0.05		0.05		0.05		0.1
L1	4	20	1988	WET	1	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.1
L1	11	23	1988	WET	2	ND	0.05	0.077	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.1
L1	2	4	1989	WET	4	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.1
L1	2	9	1989	WET	5	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.1
L1	3	2	1989	WET	6	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.1
L2	4	20	1988	WET	1	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.1
L2	11	23	1988	WET	2	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.1
L2	2	4	1989	WET	4	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.1
L2	2	9	1989	WET	5	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.1
L3	4	20	1988	WET	1	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.1
L3	11	23	1988	WET	2	ND	0.05	0.053	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.1
L3	2	4	1989	WET	4	ND	0.05	ND	0.05	ND	0.05	ND	0.05	0.18	0.05	ND	0.1
L3	2	9	1989	WET	5	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.1
L3	3	2	1989	WET	6	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.1
L4	2	4	1989	WET	4	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.1
L4	2	9	1989	WET	5	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.1
L5	11	23	1988	WET	2	ND	0.05	0.07	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.1
L5	1	23	1989	WET	3	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.1
L5	2	4	1989	WET	4	ND	0.05	ND	0.05	ND	0.05	ND	0.05	0.05	0.05	ND	0.1
L5	2	9	1989	WET	5	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.1
L5	3	2	1989	WET	6	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.1
L5FD	3	2	1989	WET	6	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.1
L6	4	20	1988	WET	1	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.05	0.2	0.1
L6	11	23	1988	WET	2	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.1
L6	2	4	1989	WET	4	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.1
L6	2	9	1989	WET	5	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.1
L7	11	23	1988	WET	2	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.1
L7	2	4	1989	WET	4	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.1
L7	2	9	1989	WET	5	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.1
L7	3	2	1989	WET	6	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.1
R1	2	27	1988	RES	1	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.1
R2	2	26	1988	RES	1	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.1
R3	2	27	1988	RES	1	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.1
R4	2	27	1988	RES	1	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.1
R5	2	27	1988	RES	1	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.1
R6	2	27	1988	RES	1	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.1

						ALDRIN		6CL-CHX-A		6CL-CHX-B		6CL-CHX-D		6CL-CHX-G		G-CHLORDANE	
Sample	Date Sampled			Sample	Sample	actual	D.L.	actual	D.L.	actual	D.L.	actual	D.L.	actual	D.L.	actual	D.L.
I.D.	Month	Day	Year	Type	Event	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l
STANDARD REPORTING OBJECTIVES							0.05		0.05		0.05		0.05		0.05		0.1
S1	2	26	1988	DRY	1	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.1
S1	3	30	1988	DRY	2	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.1
S1	5	11	1988	DRY	3	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.1
S1	12	12	1988	DRY	5	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.1
S1	2	1	1989	DRY	6	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.1
S1	4	6	1989	DRY	7	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.1
S1	11	23	1988	WET	2	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.1
S1	1	23	1989	WET	3	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.1
S1	2	4	1989	WET	4	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.1
S1	2	9	1989	WET	5	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.1
S1.FD	2	9	1989	WET	5	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.1
S1	3	2	1989	WET	6	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.1
S2	2	26	1988	DRY	1	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.1
S2	3	30	1988	DRY	2	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.1
S2	5	11	1988	DRY	3	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.1
S2	12	12	1988	DRY	5	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.1
S2	2	1	1989	DRY	6	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.1
S2	4	6	1989	DRY	7	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.1
S2	11	23	1988	WET	2	ND	0.05	0.05	0.05	ND	0.05	ND	0.05	ND	0.05	0.1	0.1
S2	1	23	1989	WET	3	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.1
S5	1	23	1989	WET	3	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.1
S2	2	4	1989	WET	4	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.1
S2	2	9	1989	WET	5	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.1
S2	3	2	1989	WET	6	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.1
S3	2	26	1988	DRY	1	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.1
S3	3	30	1988	DRY	2	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.1
S3	5	11	1988	DRY	3	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.1
S3	8	25	1988	DRY	4	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.1
S3FD	8	25	1988	DRY	4	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.1
S3	12	12	1988	DRY	5	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.1
S5	12	12	1988	DRY	5	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.1
S3	2	1	1989	DRY	6	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.1
S5	2	1	1989	DRY	6	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.1
S3	4	6	1989	DRY	7	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.1
S5	4	6	1989	DRY	7	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.1
S3	11	23	1988	WET	2	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.1
S3LR	11	23	1988	WET	2	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.1
S3	1	23	1989	WET	3	ND	0.05	ND	0.05	ND	0.05	ND	0.05	0.032	0.05	ND	0.1
S3	2	4	1989	WET	4	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.1
S3	2	4	1989	WET	4	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.1
S3	2	9	1989	WET	5	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.1

Sample I.D.	Date Sampled Month	Day	Year	Sample Type	Sample Event	ALDRIN actual ug/l	ALDRIN D.L. ug/l	6CL-CHX-A actual ug/l	6CL-CHX-A D.L. ug/l	6CL-CHX-B actual ug/l	6CL-CHX-B D.L. ug/l	6CL-CHX-D actual ug/l	6CL-CHX-D D.L. ug/l	6CL-CHX-G actual ug/l	6CL-CHX-G D.L. ug/l	G-CHLORDANE actual ug/l	G-CHLORDANE D.L. ug/l
STANDARD REPORTING OBJECTIVES							0.05		0.05		0.05		0.05		0.05		0.1
S4	2	26	1988	DRY	1	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.1
S4	3	30	1988	DRY	2	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.1
S4	5	11	1988	DRY	3	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.1
S4	8	25	1988	DRY	4	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.1
S4	12	12	1988	DRY	5	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.1
S4	2	1	1989	DRY	6	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.1
S4	4	6	1989	DRY	7	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.1
S4	4	20	1988	WET	1	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.1
S4	11	23	1988	WET	2	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.05	0.1	0.1
S4FD	11	23	1988	WET	2	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.1
S4	2	4	1989	WET	4	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.1
S4	2	9	1989	WET	5	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.1
SB	8	25	1988	DRY	4	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.1
FB	8	25	1988	DRY	4	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.1
FB	12	12	1988	DRY	5	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.1
FB	2	1	1989	DRY	6	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.1
FB	4	6	1989	DRY	7	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.1
FB	11	23	1988	WET	2	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.1
FB	1	23	1989	WET	3	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.1
FB	2	9	1989	WET	5	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.1
FB	3	2	1989	WET	6	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.05	ND	0.1

	Date Sampled					A-CHLORDANE		DDD		DDE		DDT		DIELDRIN		ENDOSLFN-A	
Sample I.D.	Month	Day	Year	Sample Type	Sample Event	actual ug/l	D.L. ug/l	actual ug/l	D.L. ug/l	actual ug/l	D.L. ug/l	actual ug/l	D.L. ug/l	actual ug/l	D.L. ug/l	actual ug/l	D.L. ug/l
STANDARD REPORTING OBJECTIVES							0.1		0.1		0.05		0.1		0.05		0.05
L1	4	20	1988	WET	1	ND	0.1	ND	0.1	ND	0.05	ND	0.1	ND	0.05	ND	0.05
L1	11	23	1988	WET	2	ND	0.1	ND	0.1	ND	0.05	ND	0.1	ND	0.1	ND	0.05
L1	2	4	1989	WET	4	ND	0.1	ND	0.1	ND	0.05	ND	0.1	ND	0.05	ND	0.05
L1	2	9	1989	WET	5	ND	0.1	ND	0.1	ND	0.05	ND	0.1	ND	0.05	ND	0.05
L1	3	2	1989	WET	6	ND	0.1	ND	0.1	ND	0.05	ND	0.1	ND	0.05	ND	0.05
L2	4	20	1988	WET	1	ND	0.1	ND	0.1	ND	0.05	ND	0.1	ND	0.05	ND	0.05
L2	11	23	1988	WET	2	ND	0.1	ND	0.1	ND	0.05	0.16	0.1	ND	0.1	ND	0.05
L2	2	4	1989	WET	4	ND	0.1	ND	0.1	ND	0.05	ND	0.1	ND	0.05	ND	0.05
L2	2	9	1989	WET	5	ND	0.1	ND	0.1	ND	0.05	ND	0.1	ND	0.05	ND	0.05
L3	4	20	1988	WET	1	ND	0.1	ND	0.1	ND	0.05	ND	0.1	ND	0.05	ND	0.05
L3	11	23	1988	WET	2	ND	0.1	ND	0.1	ND	0.05	ND	0.1	ND	0.1	ND	0.05
L3	2	4	1989	WET	4	ND	0.1	ND	0.1	ND	0.05	ND	0.1	ND	0.05	ND	0.05
L3	2	9	1989	WET	5	ND	0.1	ND	0.1	ND	0.05	ND	0.1	ND	0.05	ND	0.05
L3	3	2	1989	WET	6	ND	0.1	ND	0.1	ND	0.05	ND	0.1	ND	0.05	ND	0.05
L4	2	4	1989	WET	4	ND	0.1	ND	0.1	ND	0.05	ND	0.1	ND	0.05	ND	0.05
L4	2	9	1989	WET	5	ND	0.1	ND	0.1	ND	0.05	ND	0.1	ND	0.05	ND	0.05
L5	11	23	1988	WET	2	ND	0.1	ND	0.1	0.05	0.05	0.13	0.1	ND	0.1	ND	0.05
L5	1	23	1989	WET	3	ND	0.1	ND	0.1	ND	0.05	ND	0.1	ND	0.05	ND	0.05
L5	2	4	1989	WET	4	ND	0.1	ND	0.1	ND	0.05	ND	0.1	ND	0.05	ND	0.05
L5	2	9	1989	WET	5	ND	0.1	ND	0.1	ND	0.05	ND	0.1	ND	0.05	ND	0.05
L5	3	2	1989	WET	6	ND	0.1	ND	0.1	ND	0.05	ND	0.1	ND	0.05	ND	0.05
L5FD	3	2	1989	WET	6	ND	0.1	ND	0.1	ND	0.05	ND	0.1	ND	0.05	ND	0.05
L6	4	20	1988	WET	1	0.3	0.1	ND	0.1	0.1	0.05	ND	0.1	ND	0.05	ND	0.05
L6	11	23	1988	WET	2	ND	0.1	ND	0.1	0.074	0.05	ND	0.1	ND	0.1	ND	0.05
L6	2	4	1989	WET	4	ND	0.1	ND	0.1	ND	0.05	ND	0.1	ND	0.05	ND	0.05
L6	2	9	1989	WET	5	ND	0.1	ND	0.1	ND	0.05	ND	0.1	ND	0.05	ND	0.05
L7	11	23	1988	WET	2	ND	0.1	ND	0.1	ND	0.05	ND	0.1	ND	0.1	ND	0.05
L7	2	4	1989	WET	4	ND	0.1	ND	0.1	ND	0.05	ND	0.1	ND	0.05	ND	0.05
L7	2	9	1989	WET	5	ND	0.1	ND	0.1	ND	0.05	ND	0.1	ND	0.05	ND	0.05
L7	3	2	1989	WET	6	ND	0.1	ND	0.1	ND	0.05	ND	0.1	ND	0.05	ND	0.05
R1	2	27	1988	RES	1	ND	0.1	ND	0.1	ND	0.05	ND	0.1	ND	0.05	ND	0.05
R2	2	26	1988	RES	1	ND	0.1	ND	0.1	ND	0.05	ND	0.1	ND	0.05	ND	0.05
R3	2	27	1988	RES	1	ND	0.1	ND	0.1	ND	0.05	ND	0.1	ND	0.05	ND	0.05
R4	2	27	1988	RES	1	ND	0.1	ND	0.1	ND	0.05	ND	0.1	ND	0.05	ND	0.05
R5	2	27	1988	RES	1	ND	0.1	ND	0.1	ND	0.05	ND	0.1	ND	0.05	ND	0.05
R6	2	27	1988	RES	1	ND	0.1	ND	0.1	ND	0.05	ND	0.1	ND	0.05	ND	0.05

Sample I.D.	Date Sampled Month	Day	Year	Sample Type	Sample Event	A-CHLORDANE actual ug/l	D.L. ug/l	DDD actual ug/l	D.L. ug/l	DDE actual ug/l	D.L. ug/l	DDT actual ug/l	D.L. ug/l	DIELDRIN actual ug/l	D.L. ug/l	ENDOSLFN-A actual ug/l	D.L. ug/l
STANDARD REPORTING OBJECTIVES							0.1		0.1		0.05		0.1		0.05		0.05
S1	2	26	1988	DRY	1	ND	0.1	ND	0.1	ND	0.05	ND	0.1	ND	0.05	ND	0.05
S1	3	30	1988	DRY	2	ND	0.1	ND	0.1	ND	0.05	ND	0.1	ND	0.05	ND	0.05
S1	5	11	1988	DRY	3	ND	0.1	ND	0.1	ND	0.05	ND	0.1	ND	0.05	ND	0.05
S1	12	12	1988	DRY	5	ND	0.1	ND	0.1	ND	0.05	ND	0.1	ND	0.05	ND	0.05
S1	2	1	1989	DRY	6	ND	0.1	ND	0.1	ND	0.05	ND	0.1	ND	0.05	ND	0.05
S1	4	6	1989	DRY	7	ND	0.1	ND	0.1	ND	0.05	ND	0.1	ND	0.1	ND	0.05
S1	11	23	1988	WET	2	ND	0.1	ND	0.1	ND	0.05	ND	0.1	ND	0.1	ND	0.05
S1	1	23	1989	WET	3	ND	0.1	ND	0.1	ND	0.05	ND	0.1	ND	0.05	ND	0.05
S1	2	4	1989	WET	4	ND	0.1	ND	0.1	ND	0.05	ND	0.1	ND	0.05	ND	0.05
S1	2	9	1989	WET	5	ND	0.1	ND	0.1	ND	0.05	ND	0.1	ND	0.05	ND	0.05
S1.FD	2	9	1989	WET	5	ND	0.1	ND	0.1	ND	0.05	ND	0.1	ND	0.05	ND	0.05
S1	3	2	1989	WET	6	ND	0.1	ND	0.1	ND	0.05	ND	0.1	ND	0.05	ND	0.05
S2	2	26	1988	DRY	1	ND	0.1	ND	0.1	ND	0.05	ND	0.1	ND	0.05	ND	0.05
S2	3	30	1988	DRY	2	ND	0.1	ND	0.1	ND	0.05	ND	0.1	ND	0.05	ND	0.05
S2	5	11	1988	DRY	3	ND	0.1	ND	0.1	ND	0.05	ND	0.1	ND	0.05	ND	0.05
S2	12	12	1988	DRY	5	ND	0.1	ND	0.1	ND	0.05	ND	0.1	ND	0.05	ND	0.05
S2	2	1	1989	DRY	6	ND	0.1	ND	0.1	ND	0.05	ND	0.1	ND	0.05	ND	0.05
S2	4	6	1989	DRY	7	ND	0.1	ND	0.1	ND	0.05	ND	0.1	ND	0.1	ND	0.05
S2	11	23	1988	WET	2	ND	0.1	0.13	0.1	0.08	0.05	0.25	0.1	ND	0.1	ND	0.05
S2	1	23	1989	WET	3	ND	0.1	ND	0.1	ND	0.05	ND	0.1	ND	0.05	ND	0.05
S5	1	23	1989	WET	3	ND	0.1	ND	0.1	ND	0.05	ND	0.1	ND	0.05	ND	0.05
S2	2	4	1989	WET	4	ND	0.1	ND	0.1	ND	0.05	ND	0.1	ND	0.05	ND	0.05
S2	2	9	1989	WET	5	ND	0.1	ND	0.1	ND	0.05	ND	0.1	ND	0.05	ND	0.05
S2	3	2	1989	WET	6	0.1	0.1	ND	0.1	ND	0.05	ND	0.1	ND	0.05	ND	0.05
S3	2	26	1988	DRY	1	ND	0.1	ND	0.1	ND	0.05	ND	0.1	ND	0.05	ND	0.05
S3	3	30	1988	DRY	2	ND	0.1	ND	0.1	ND	0.05	ND	0.1	ND	0.05	ND	0.05
S3	5	11	1988	DRY	3	ND	0.1	ND	0.1	ND	0.05	ND	0.1	ND	0.05	ND	0.05
S3	8	25	1988	DRY	4	ND	0.1	ND	0.1	ND	0.05	ND	0.1	ND	0.1	ND	0.05
S3FD	8	25	1988	DRY	4	ND	0.1	ND	0.1	ND	0.05	ND	0.1	ND	0.1	ND	0.05
S3	12	12	1988	DRY	5	ND	0.1	ND	0.1	ND	0.05	ND	0.1	ND	0.05	ND	0.05
S5	12	12	1988	DRY	5	ND	0.1	ND	0.1	ND	0.05	ND	0.1	ND	0.05	ND	0.05
S3	2	1	1989	DRY	6	ND	0.1	ND	0.1	ND	0.05	ND	0.1	ND	0.05	ND	0.05
S5	2	1	1989	DRY	6	ND	0.1	ND	0.1	ND	0.05	ND	0.1	ND	0.05	ND	0.05
S3	4	6	1989	DRY	7	ND	0.1	ND	0.1	ND	0.05	ND	0.1	ND	0.1	ND	0.05
S5	4	6	1989	DRY	7	ND	0.1	ND	0.1	ND	0.05	ND	0.1	ND	0.1	ND	0.05
S3	11	23	1988	WET	2	ND	0.1	ND	0.1	ND	0.05	ND	0.1	ND	0.1	ND	0.05
S3LR	11	23	1988	WET	2	ND	0.1	ND	0.1	ND	0.05	ND	0.1	ND	0.1	ND	0.05
S3	1	23	1989	WET	3	ND	0.1	ND	0.1	ND	0.05	ND	0.1	ND	0.05	ND	0.05
S3	2	4	1989	WET	4	ND	0.1	ND	0.1	ND	0.05	ND	0.1	ND	0.05	ND	0.05
S3	2	4	1989	WET	4	ND	0.1	ND	0.1	ND	0.05	ND	0.1	ND	0.05	ND	0.05
S3	2	9	1989	WET	5	ND	0.1	ND	0.1	ND	0.05	ND	0.1	ND	0.05	ND	0.05

Sample	Date Sampled			Sample	Sample	A-CHLORDANE		DDD		DDE		DDT		DIELDRIN		ENDOSLFN-A	
I.D.	Month	Day	Year	Type	Event	actual ug/l	D.L. ug/l	actual ug/l	D.L. ug/l	actual ug/l	D.L. ug/l	actual ug/l	D.L. ug/l	actual ug/l	D.L. ug/l	actual ug/l	D.L. ug/l
STANDARD REPORTING OBJECTIVES							0.1		0.1		0.05		0.1		0.05		0.05
S4	2	26	1988	DRY	1	ND	0.1	ND	0.1	ND	0.05	ND	0.1	ND	0.05	ND	0.05
S4	3	30	1988	DRY	2	ND	0.1	ND	0.1	ND	0.05	ND	0.1	ND	0.05	ND	0.05
S4	5	11	1988	DRY	3	ND	0.1	ND	0.1	ND	0.05	ND	0.1	ND	0.05	ND	0.05
S4	8	25	1988	DRY	4	ND	0.1	ND	0.1	ND	0.05	ND	0.1	ND	0.1	ND	0.05
S4	12	12	1988	DRY	5	ND	0.1	ND	0.1	ND	0.05	ND	0.1	ND	0.05	ND	0.05
S4	2	1	1989	DRY	6	ND	0.1	ND	0.1	ND	0.05	ND	0.1	ND	0.05	ND	0.05
S4	4	6	1989	DRY	7	ND	0.1	ND	0.1	ND	0.05	ND	0.1	ND	0.1	ND	0.05
S4	4	20	1988	WET	1	ND	0.1	ND	0.1	ND	0.05	ND	0.1	ND	0.05	ND	0.05
S4	11	23	1988	WET	2	ND	0.1	ND	0.1	0.07	0.05	0.19	0.1	ND	0.1	0.13	0.05
S4FD	11	23	1988	WET	2	ND	0.1	ND	0.1	0.05	0.05	0.15	0.1	ND	0.1	ND	0.05
S4	2	4	1989	WET	4	ND	0.1	ND	0.1	0.05	0.05	0.05	0.1	ND	0.05	ND	0.05
S4	2	9	1989	WET	5	ND	0.1	ND	0.1	ND	0.05	ND	0.1	ND	0.05	ND	0.05
SB	8	25	1988	DRY	4	ND	0.1	ND	0.1	ND	0.05	ND	0.1	ND	0.1	ND	0.05
FB	8	25	1988	DRY	4	ND	0.1	ND	0.1	ND	0.05	ND	0.1	ND	0.1	ND	0.05
FB	12	12	1988	DRY	5	ND	0.1	ND	0.1	ND	0.05	ND	0.1	ND	0.05	ND	0.05
FB	2	1	1989	DRY	6	ND	0.1	ND	0.1	ND	0.05	ND	0.1	ND	0.05	ND	0.05
FB	4	6	1989	DRY	7	ND	0.1	ND	0.1	ND	0.05	ND	0.1	ND	0.1	ND	0.05
FB	11	23	1988	WET	2	ND	0.1	ND	0.1	ND	0.05	ND	0.1	ND	0.1	ND	0.05
FB	1	23	1989	WET	3	ND	0.1	ND	0.1	0.077	0.05	ND	0.1	ND	0.05	ND	0.05
FB	2	9	1989	WET	5	ND	0.1	ND	0.1	ND	0.05	ND	0.1	ND	0.05	ND	0.05
FB	3	2	1989	WET	6	ND	0.1	ND	0.1	ND	0.05	ND	0.1	ND	0.05	ND	0.05

Sample I.D.	Date Sampled Month	Day	Year	Sample Type	Sample Event	ENDOSLFN-B actual ug/l	D.L. ug/l	ENDOSLFN-S actual ug/l	D.L. ug/l	ENDRIN actual ug/l	D.L. ug/l	ENDRIN-ALD actual ug/l	D.L. ug/l	HEPTACHLOR actual ug/l	D.L. ug/l
STANDARD REPORTING OBJECTIVES							0.05		0.1		0.1		0.1		0.05
L1	4	20	1988	WET	1	ND	0.05	0.12	0.1	ND	0.1	ND	0.1	ND	0.05
L1	11	23	1988	WET	2	ND	0.1	ND	0.1	ND	0.1	ND	0.1	ND	0.05
L1	2	4	1989	WET	4	ND	0.05	ND	0.1	ND	0.1	ND	0.1	ND	0.05
L1	2	9	1989	WET	5	ND	0.05	ND	0.1	ND	0.1	ND	0.1	ND	0.05
L1	3	2	1989	WET	6	ND	0.05	ND	0.1	ND	0.1	ND	0.1	ND	0.05
L2	4	20	1988	WET	1	ND	0.05	ND	0.1	ND	0.1	ND	0.1	ND	0.05
L2	11	23	1988	WET	2	ND	0.1	ND	0.1	ND	0.1	ND	0.1	ND	0.05
L2	2	4	1989	WET	4	ND	0.05	ND	0.1	ND	0.1	ND	0.1	ND	0.05
L2	2	9	1989	WET	5	ND	0.05	ND	0.1	ND	0.1	ND	0.1	ND	0.05
L3	4	20	1988	WET	1	ND	0.05	ND	0.1	ND	0.1	ND	0.1	ND	0.05
L3	11	23	1988	WET	2	ND	0.1	ND	0.1	ND	0.1	ND	0.1	ND	0.05
L3	2	4	1989	WET	4	ND	0.05	ND	0.1	ND	0.1	ND	0.1	ND	0.05
L3	2	9	1989	WET	5	ND	0.05	ND	0.1	ND	0.1	ND	0.1	ND	0.05
L3	3	2	1989	WET	6	ND	0.05	ND	0.1	ND	0.1	ND	0.1	ND	0.05
L4	2	4	1989	WET	4	ND	0.05	ND	0.1	ND	0.1	ND	0.1	ND	0.05
L4	2	9	1989	WET	5	ND	0.05	ND	0.1	ND	0.1	ND	0.1	ND	0.05
L5	11	23	1988	WET	2	ND	0.1	ND	0.1	ND	0.1	ND	0.1	ND	0.05
L5	1	23	1989	WET	3	ND	0.05	ND	0.1	ND	0.1	ND	0.1	ND	0.05
L5	2	4	1989	WET	4	ND	0.05	ND	0.1	ND	0.1	ND	0.1	ND	0.05
L5	2	9	1989	WET	5	ND	0.05	ND	0.1	ND	0.1	ND	0.1	ND	0.05
L5	3	2	1989	WET	6	ND	0.05	ND	0.1	ND	0.1	ND	0.1	ND	0.05
L5FD	3	2	1989	WET	6	ND	0.05	ND	0.1	ND	0.1	ND	0.1	ND	0.05
L6	4	20	1988	WET	1	ND	0.05	ND	0.1	ND	0.1	ND	0.1	ND	0.05
L6	11	23	1988	WET	2	ND	0.1	ND	0.1	ND	0.1	ND	0.1	ND	0.05
L6	2	4	1989	WET	4	ND	0.05	ND	0.1	ND	0.1	ND	0.1	ND	0.05
L6	2	9	1989	WET	5	ND	0.05	ND	0.1	ND	0.1	ND	0.1	ND	0.05
L7	11	23	1988	WET	2	ND	0.1	ND	0.1	ND	0.1	ND	0.1	ND	0.05
L7	2	4	1989	WET	4	ND	0.05	ND	0.1	ND	0.1	ND	0.1	ND	0.05
L7	2	9	1989	WET	5	ND	0.05	ND	0.1	ND	0.1	ND	0.1	ND	0.05
L7	3	2	1989	WET	6	ND	0.05	ND	0.1	ND	0.1	ND	0.1	ND	0.05
R1	2	27	1988	RES	1	ND	0.05	ND	0.1	ND	0.1	ND	0.1	ND	0.05
R2	2	26	1988	RES	1	ND	0.05	ND	0.1	ND	0.1	ND	0.1	ND	0.05
R3	2	27	1988	RES	1	ND	0.05	ND	0.1	ND	0.1	ND	0.1	ND	0.05
R4	2	27	1988	RES	1	ND	0.05	ND	0.1	ND	0.1	ND	0.1	ND	0.05
R5	2	27	1988	RES	1	ND	0.05	ND	0.1	ND	0.1	ND	0.1	ND	0.05
R6	2	27	1988	RES	1	ND	0.05	ND	0.1	ND	0.1	ND	0.1	ND	0.05

Sample I.D.	Date Sampled Month	Day	Year	Sample Type	Sample Event	ENDOSLFN-B actual ug/l	D.L. ug/l	ENDOSLFN-S actual ug/l	D.L. ug/l	ENDRIN actual ug/l	D.L. ug/l	ENDRIN-ALD actual ug/l	D.L. ug/l	HEPTACHLOR actual ug/l	D.L. ug/l
STANDARD REPORTING OBJECTIVES							0.05		0.1		0.1		0.1		0.05
S1	2	26	1988	DRY	1	ND	0.05	ND	0.1	ND	0.1	ND	0.1	ND	0.05
S1	3	30	1988	DRY	2	ND	0.05	ND	0.1	ND	0.1	ND	0.1	ND	0.05
S1	5	11	1988	DRY	3	ND	0.05	ND	0.1	ND	0.1	ND	0.1	ND	0.05
S1	12	12	1988	DRY	5	ND	0.05	ND	0.1	ND	0.1	ND	0.1	ND	0.05
S1	2	1	1989	DRY	6	ND	0.05	ND	0.1	ND	0.1	ND	0.1	ND	0.05
S1	4	6	1989	DRY	7	ND	0.05	ND	0.1	ND	0.1	ND	0.1	ND	0.05
S1	11	23	1988	WET	2	ND	0.1	ND	0.1	ND	0.1	ND	0.1	ND	0.05
S1	1	23	1989	WET	3	ND	0.05	ND	0.1	ND	0.1	ND	0.1	ND	0.05
S1	2	4	1989	WET	4	ND	0.05	ND	0.1	ND	0.1	ND	0.1	ND	0.05
S1	2	9	1989	WET	5	ND	0.05	ND	0.1	ND	0.1	ND	0.1	ND	0.05
S1.FD	2	9	1989	WET	5	ND	0.05	ND	0.1	ND	0.1	ND	0.1	ND	0.05
S1	3	2	1989	WET	6	ND	0.05	ND	0.1	ND	0.1	ND	0.1	ND	0.05
S2	2	26	1988	DRY	1	ND	0.05	ND	0.1	ND	0.1	ND	0.1	ND	0.05
S2	3	30	1988	DRY	2	ND	0.05	ND	0.1	ND	0.1	ND	0.1	ND	0.05
S2	5	11	1988	DRY	3	ND	0.05	ND	0.1	ND	0.1	ND	0.1	ND	0.05
S2	12	12	1988	DRY	5	ND	0.05	ND	0.1	ND	0.1	ND	0.1	ND	0.05
S2	2	1	1989	DRY	6	ND	0.05	ND	0.1	ND	0.1	ND	0.1	ND	0.05
S2	4	6	1989	DRY	7	ND	0.05	ND	0.1	ND	0.1	ND	0.1	ND	0.05
S2	11	23	1988	WET	2	ND	0.1	ND	0.1	ND	0.1	ND	0.1	ND	0.05
S2	1	23	1989	WET	3	ND	0.05	ND	0.1	ND	0.1	ND	0.1	ND	0.05
S5	1	23	1989	WET	3	ND	0.05	ND	0.1	ND	0.1	ND	0.1	ND	0.05
S2	2	4	1989	WET	4	ND	0.05	ND	0.1	ND	0.1	ND	0.1	ND	0.05
S2	2	9	1989	WET	5	ND	0.05	ND	0.1	ND	0.1	ND	0.1	ND	0.05
S2	3	2	1989	WET	6	ND	0.05	ND	0.1	ND	0.1	ND	0.1	ND	0.05
S3	2	26	1988	DRY	1	ND	0.05	ND	0.1	ND	0.1	ND	0.1	ND	0.05
S3	3	30	1988	DRY	2	ND	0.05	ND	0.1	ND	0.1	ND	0.1	ND	0.05
S3	5	11	1988	DRY	3	ND	0.05	ND	0.1	ND	0.1	ND	0.1	ND	0.05
S3	8	25	1988	DRY	4	ND	0.1	ND	0.1	ND	0.1	ND	0.1	ND	0.05
S3FD	8	25	1988	DRY	4	ND	0.1	ND	0.1	ND	0.1	ND	0.1	ND	0.05
S3	12	12	1988	DRY	5	ND	0.05	ND	0.1	ND	0.1	ND	0.1	ND	0.05
S5	12	12	1988	DRY	5	ND	0.05	ND	0.1	ND	0.1	ND	0.1	ND	0.05
S3	2	1	1989	DRY	6	ND	0.05	ND	0.1	ND	0.1	ND	0.1	ND	0.05
S5	2	1	1989	DRY	6	ND	0.05	ND	0.1	ND	0.1	ND	0.1	ND	0.05
S3	4	6	1989	DRY	7	ND	0.05	ND	0.1	ND	0.1	ND	0.1	ND	0.05
S5	4	6	1989	DRY	7	ND	0.05	ND	0.1	ND	0.1	ND	0.1	ND	0.05
S3	11	23	1988	WET	2	ND	0.1	ND	0.1	ND	0.1	ND	0.1	ND	0.05
S3LR	11	23	1988	WET	2	ND	0.1	ND	0.1	ND	0.1	ND	0.1	ND	0.05
S3	1	23	1989	WET	3	ND	0.05	ND	0.1	ND	0.1	ND	0.1	ND	0.05
S3	2	4	1989	WET	4	ND	0.05	ND	0.1	ND	0.1	ND	0.1	ND	0.05
S3	2	4	1989	WET	4	ND	0.05	ND	0.1	ND	0.1	ND	0.1	ND	0.05
S3	2	9	1989	WET	5	ND	0.05	ND	0.1	ND	0.1	ND	0.1	ND	0.05

	Date Sampled					ENDOSLFN-B		ENDOSLFN-S		ENDRIN		ENDRIN-ALD		HEPTACHLOR	
Sample I.D.	Month	Day	Year	Sample Type	Sample Event	actual ug/l	D.L. ug/l	actual ug/l	D.L. ug/l	actual ug/l	D.L. ug/l	actual ug/l	D.L. ug/l	actual ug/l	D.L. ug/l
STANDARD REPORTING OBJECTIVES							0.05		0.1		0.1		0.1		0.05
S4	2	26	1988	DRY	1	ND	0.05	ND	0.1	ND	0.1	ND	0.1	ND	0.05
S4	3	30	1988	DRY	2	ND	0.05	ND	0.1	ND	0.1	ND	0.1	ND	0.05
S4	5	11	1988	DRY	3	ND	0.05	ND	0.1	ND	0.1	ND	0.1	ND	0.05
S4	8	25	1988	DRY	4	ND	0.1	ND	0.1	ND	0.1	ND	0.1	ND	0.05
S4	12	12	1988	DRY	5	ND	0.05	ND	0.1	ND	0.1	ND	0.1	ND	0.05
S4	2	1	1989	DRY	6	ND	0.05	ND	0.1	ND	0.1	ND	0.1	ND	0.05
S4	4	6	1989	DRY	7	ND	0.05	ND	0.1	ND	0.1	ND	0.1	ND	0.05
S4	4	20	1988	WET	1	ND	0.05	ND	0.1	ND	0.1	ND	0.1	ND	0.05
S4	11	23	1988	WET	2	0.06	0.1	ND	0.1	ND	0.1	ND	0.1	ND	0.05
S4FD	11	23	1988	WET	2	ND	0.1	ND	0.1	ND	0.1	ND	0.1	ND	0.05
S4	2	4	1989	WET	4	ND	0.05	ND	0.1	ND	0.1	ND	0.1	ND	0.05
S4	2	9	1989	WET	5	ND	0.05	ND	0.1	ND	0.1	ND	0.1	ND	0.05
SB	8	25	1988	DRY	4	ND	0.1	ND	0.1	ND	0.1	ND	0.1	ND	0.05
FB	8	25	1988	DRY	4	ND	0.1	ND	0.1	ND	0.1	ND	0.1	ND	0.05
FB	12	12	1988	DRY	5	ND	0.05	ND	0.1	ND	0.1	ND	0.1	ND	0.05
FB	2	1	1989	DRY	6	ND	0.05	ND	0.1	ND	0.1	ND	0.1	ND	0.05
FB	4	6	1989	DRY	7	ND	0.05	ND	0.1	ND	0.1	ND	0.1	ND	0.05
FB	11	23	1988	WET	2	ND	0.1	ND	0.1	ND	0.1	ND	0.1	ND	0.05
FB	1	23	1989	WET	3	ND	0.05	ND	0.1	ND	0.1	ND	0.1	ND	0.05
FB	2	9	1989	WET	5	ND	0.05	ND	0.1	ND	0.1	ND	0.1	ND	0.05
FB	3	2	1989	WET	6	ND	0.05	ND	0.1	ND	0.1	ND	0.1	ND	0.05

						HEPCL EPOX		METHOXYCL		TOXAPHENE		tPCB	
Sample I.D.	Date Sampled Month	Day	Year	Sample Type	Sample Event	actual ug/l	D.L. ug/l	actual ug/l	D.L. ug/l	actual ug/l	D.L. ug/l	actual ug/l	D.L. ug/l
STANDARD REPORTING OBJECTIVES							0.05		0.05		1		1
L1	4	20	1988	WET	1	ND	0.05	ND	0.05	ND	1	ND	1
L1	11	23	1988	WET	2	ND	0.05	ND	0.5	ND	1	ND	1
L1	2	4	1989	WET	4	ND	0.05	ND	0.5	ND	1.0	ND	1.0
L1	2	9	1989	WET	5	ND	0.05	ND	0.5	ND	1.0	ND	1.0
L1	3	2	1989	WET	6	ND	0.05	ND	0.5	ND	1.0	ND	1.0
L2	4	20	1988	WET	1	ND	0.05	ND	0.05	ND	1	ND	1
L2	11	23	1988	WET	2	ND	0.05	ND	0.5	ND	1	ND	1
L2	2	4	1989	WET	4	ND	0.05	ND	0.5	ND	1.0	ND	1.0
L2	2	9	1989	WET	5	ND	0.05	ND	0.5	ND	1.0	ND	1.0
L3	4	20	1988	WET	1	ND	0.05	ND	0.05	ND	1	ND	1
L3	11	23	1988	WET	2	ND	0.05	ND	0.5	ND	1	ND	1
L3	2	4	1989	WET	4	ND	0.05	ND	0.5	ND	1.0	ND	1.0
L3	2	9	1989	WET	5	ND	0.05	ND	0.5	ND	1.0	ND	1.0
L3	3	2	1989	WET	6	ND	0.05	ND	0.5	ND	1.0	ND	1.0
L4	2	4	1989	WET	4	ND	0.05	ND	0.5	ND	1.0	ND	1.0
L4	2	9	1989	WET	5	ND	0.05	ND	0.5	ND	1.0	ND	1.0
L5	11	23	1988	WET	2	ND	0.05	ND	0.5	ND	1	ND	1
L5	1	23	1989	WET	3	ND	0.05	ND	0.5	ND	1	ND	1
L5	2	4	1989	WET	4	ND	0.05	ND	0.5	ND	1.0	ND	1.0
L5	2	9	1989	WET	5	ND	0.05	ND	0.5	ND	1.0	ND	1.0
L5	3	2	1989	WET	6	ND	0.05	ND	0.5	ND	1.0	ND	1.0
L5FD	3	2	1989	WET	6	ND	0.05	ND	0.5	ND	1.0	ND	1.0
L6	4	20	1988	WET	1	ND	0.05	ND	0.05	ND	1	1.4	1
L6	11	23	1988	WET	2	ND	0.05	ND	0.5	ND	1	ND	1
L6	2	4	1989	WET	4	ND	0.05	ND	0.5	ND	1.0	ND	1.0
L6	2	9	1989	WET	5	ND	0.05	ND	0.5	ND	1.0	ND	1.0
L7	11	23	1988	WET	2	ND	0.05	ND	0.5	ND	1	ND	1
L7	2	4	1989	WET	4	ND	0.05	ND	0.5	ND	1.0	ND	1.0
L7	2	9	1989	WET	5	ND	0.05	ND	0.5	ND	1.0	ND	1.0
L7	3	2	1989	WET	6	ND	0.05	ND	0.5	ND	1.0	ND	1.0
R1	2	27	1988	RES	1	ND	0.05	ND	0.05	ND	1	ND	1
R2	2	26	1988	RES	1	ND	0.05	ND	0.05	ND	1	ND	1
R3	2	27	1988	RES	1	ND	0.05	ND	0.05	ND	1	ND	1
R4	2	27	1988	RES	1	ND	0.05	ND	0.05	ND	1	ND	1
R5	2	27	1988	RES	1	ND	0.05	ND	0.05	ND	1	ND	1
R6	2	27	1988	RES	1	ND	0.05	ND	0.05	ND	1	ND	1

Sample	Date Sampled			Sample	Sample	HEPCL EPOX actual	D.L.	METHOXYCL actual	D.L.	TOXAPHENE actual	D.L.	tPCB actual	D.L.
I.D.	Month	Day	Year	Type	Event	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l
STANDARD REPORTING OBJECTIVES							0.05		0.05		1		1
S1	2	26	1988	DRY	1	ND	0.05	ND	0.05	ND	1	ND	1
S1	3	30	1988	DRY	2	ND	0.05	ND	0.05	ND	1	ND	1
S1	5	11	1988	DRY	3	ND	0.05	ND	0.05	ND	1	ND	1
S1	12	12	1988	DRY	5	ND	0.05	ND	0.5	ND	1	ND	1
S1	2	1	1989	DRY	6	ND	0.05	ND	0.5	ND	1	ND	1
S1	4	6	1989	DRY	7	ND	0.05	ND	0.5	ND	1.0	ND	1.0
S1	11	23	1988	WET	2	ND	0.05	ND	0.5	ND	1	ND	1
S1	1	23	1989	WET	3	ND	0.05	ND	0.5	ND	1	ND	1
S1	2	4	1989	WET	4	ND	0.05	ND	0.5	ND	1.0	ND	1.0
S1	2	9	1989	WET	5	ND	0.05	ND	0.5	ND	1.0	ND	1.0
S1.FD	2	9	1989	WET	5	ND	0.05	ND	0.5	ND	1.0	ND	1.0
S1	3	2	1989	WET	6	ND	0.05	ND	0.5	ND	1.0	ND	1.0
S2	2	26	1988	DRY	1	ND	0.05	ND	0.05	ND	1	ND	1
S2	3	30	1988	DRY	2	ND	0.05	ND	0.05	ND	1	ND	1
S2	5	11	1988	DRY	3	ND	0.05	ND	0.05	ND	1	ND	1
S2	12	12	1988	DRY	5	ND	0.05	ND	0.5	ND	1	ND	1
S2	2	1	1989	DRY	6	ND	0.05	ND	0.5	ND	1	ND	1
S2	4	6	1989	DRY	7	ND	0.05	ND	0.5	ND	1.0	ND	1.0
S2	11	23	1988	WET	2	ND	0.05	ND	0.5	ND	1	ND	1
S2	1	23	1989	WET	3	ND	0.05	ND	0.5	ND	1	ND	1
S5	1	23	1989	WET	3	ND	0.05	ND	0.5	ND	1	ND	1
S2	2	4	1989	WET	4	ND	0.05	ND	0.5	ND	1.0	ND	1.0
S2	2	9	1989	WET	5	ND	0.05	ND	0.5	ND	1.0	ND	1.0
S2	3	2	1989	WET	6	ND	0.05	ND	0.5	ND	1.0	ND	1.0
S3	2	26	1988	DRY	1	ND	0.05	ND	0.05	ND	1	ND	1
S3	3	30	1988	DRY	2	ND	0.05	ND	0.05	ND	1	ND	1
S3	5	11	1988	DRY	3	ND	0.05	ND	0.05	ND	1	ND	1
S3	8	25	1988	DRY	4	ND	0.05	ND	0.5	ND	1	ND	1
S3FD	8	25	1988	DRY	4	ND	0.05	ND	0.5	ND	1	ND	1
S3	12	12	1988	DRY	5	ND	0.05	ND	0.5	ND	1	ND	1
S5	12	12	1988	DRY	5	ND	0.05	ND	0.5	ND	1	ND	1
S3	2	1	1989	DRY	6	ND	0.05	ND	0.5	ND	1	ND	1
S5	2	1	1989	DRY	6	ND	0.05	ND	0.5	ND	1	ND	1
S3	4	6	1989	DRY	7	ND	0.05	ND	0.5	ND	1.0	ND	1.0
S5	4	6	1989	DRY	7	ND	0.05	ND	0.5	ND	1.0	ND	1.0
S3	11	23	1988	WET	2	ND	0.05	ND	0.5	ND	1	ND	1
S3LR	11	23	1988	WET	2	ND	0.05	ND	0.5	ND	1	ND	1
S3	1	23	1989	WET	3	ND	0.05	ND	0.5	ND	1	ND	1
S3	2	4	1989	WET	4	ND	0.05	ND	0.5	ND	1.0	ND	1.0
S3	2	4	1989	WET	4	ND	0.05	ND	0.5	ND	1.0	ND	1.0
S3	2	9	1989	WET	5	ND	0.05	ND	0.5	ND	1.0	ND	1.0

						HEPCL EPOX		METHOXYCL		TOXAPHENE		tPCB	
Sample I.D.	Date Sampled Month	Day	Year	Sample Type	Sample Event	actual ug/l	D.L. ug/l	actual ug/l	D.L. ug/l	actual ug/l	D.L. ug/l	actual ug/l	D.L. ug/l
STANDARD REPORTING OBJECTIVES							0.05		0.05		1		1
S4	2	26	1988	DRY	1	ND	0.05	ND	0.05	ND	1	ND	1
S4	3	30	1988	DRY	2	ND	0.05	ND	0.05	ND	1	ND	1
S4	5	11	1988	DRY	3	ND	0.05	ND	0.05	ND	1	1.3	1
S4	8	25	1988	DRY	4	ND	0.05	ND	0.5	ND	1	ND	1
S4	12	12	1988	DRY	5	ND	0.05	ND	0.5	ND	1	ND	1
S4	2	1	1989	DRY	6	ND	0.05	ND	0.5	ND	1	ND	1
S4	4	6	1989	DRY	7	ND	0.05	ND	0.5	ND	1.0	ND	1.0
S4	4	20	1988	WET	1	ND	0.05	ND	0.05	ND	1	ND	1
S4	11	23	1988	WET	2	ND	0.05	ND	0.5	ND	1	ND	1
S4FD	11	23	1988	WET	2	ND	0.05	ND	0.5	ND	1	1.4	1
S4	2	4	1989	WET	4	ND	0.05	ND	0.5	ND	1.0	ND	1.0
S4	2	9	1989	WET	5	ND	0.05	ND	0.5	ND	1.0	ND	1.0
SB	8	25	1988	DRY	4	ND	0.05	ND	0.5	ND	1	1.3	1
FB	8	25	1988	DRY	4	ND	0.05	ND	0.5	ND	1	1.3	1
FB	12	12	1988	DRY	5	ND	0.05	ND	0.5	ND	1	ND	1
FB	2	1	1989	DRY	6	ND	0.05	ND	0.5	ND	1	ND	1
FB	4	6	1989	DRY	7	ND	0.05	ND	0.5	ND	1.0	ND	1.0
FB	11	23	1988	WET	2	ND	0.05	ND	0.5	ND	1	ND	1
FB	1	23	1989	WET	3	ND	0.05	ND	0.5	ND	1	ND	1
FB	2	9	1989	WET	5	ND	0.05	ND	0.5	ND	1.0	ND	1.0
FB	3	2	1989	WET	6	ND	0.05	ND	0.5	ND	1.0	ND	1.0

D.3-2 Organochlorine pesticides in sediment

Sample I.D.	Date Sampled			Sample Type	Sample Event	ALDRIN		6CL-CHX-A		6CL-CHX-B		6CL-CHX-D		6CL-CHX-G	
	Month	Day	Year			actual µg/kg	D.L. µg/kg	actual µg/kg	D.L. µg/kg	actual µg/kg	D.L. µg/kg	actual µg/kg	D.L. µg/kg	actual µg/kg	D.L. µg/kg
STANDARD REPORTING OBJECTIVES							2		2		2		2		2
S1	3	30	1988	DRY	1	ND	2	ND	2	ND	2	ND	2	ND	2
S1	5	11	1988	DRY	2	ND	5	ND	5	ND	5	ND	5	ND	5
S1	8	22	1988	DRY	3	ND	5	ND	5	ND	5	ND	5	5	5
S1	12	12	1988	DRY	4	ND	4	ND	4	ND	4	ND	4	ND	4
S2	3	30	1988	DRY	1	ND	2	ND	2	ND	2	ND	2	ND	2
S2	5	11	1988	DRY	2	ND	5	ND	5	ND	5	ND	5	ND	5
S2	8	22	1988	DRY	3	ND	5	ND	5	ND	5	ND	5	ND	5
S2	12	12	1988	DRY	4	ND	4	ND	4	ND	4	ND	4	ND	4
S3	3	30	1988	DRY	1	ND	2	ND	2	ND	2	ND	2	ND	2
S3	5	11	1988	DRY	2	ND	5	ND	5	ND	5	ND	5	ND	5
S3	8	22	1988	DRY	3	ND	5	ND	5	ND	5	ND	5	ND	5
S3	12	12	1988	DRY	4	ND	4	ND	4	ND	4	ND	4	ND	4
S3FD	8	22	1988	DRY	3	ND	5	ND	5	ND	5	ND	5	7.8	5
S3FD	12	12	1988	DRY	4	ND	4	ND	4	ND	4	ND	4	ND	4
S4	3	30	1988	DRY	1	ND	2	ND	2	ND	2	ND	2	ND	2
S4	5	11	1988	DRY	2	ND	5	ND	5	ND	5	ND	5	ND	5
S4	8	22	1988	DRY	3	ND	5	ND	5	ND	5	ND	5	ND	5
S4	12	12	1988	DRY	4	ND	4	ND	4	ND	4	ND	4	ND	4
S4LR	3	30	1988	DRY	1	ND	2	ND	2	ND	2	ND	2	ND	2

Sample I.D.	Date Sampled Month	Day	Year	Sample Type	Sample Event	G-CHLORDANE actual µg/kg	D.L. µg/kg	A-CHLORDANE actual µg/kg	D.L. µg/kg	DDD actual µg/kg	D.L. µg/kg	DDE actual µg/kg	D.L. µg/kg	DDT actual µg/kg	D.L. µg/kg	DIELDRIN actual µg/kg	D.L. µg/kg
STANDARD REPORTING OBJECTIVES							4		3		2		2		4		2
S1	3	30	1988	DRY	1	ND	4	ND	3	2	2	2.4	2	ND	4	ND	2
S1	5	11	1988	DRY	2	6	6	8	6	ND	10	ND	5	ND	10	ND	5
S1	8	22	1988	DRY	3	ND	10	ND	10	ND	10	7	5	ND	10	ND	10
S1	12	12	1988	DRY	4	11	8	8.3	8	13	8	14	4	13	8	ND	4
S2	3	30	1988	DRY	1	7.4	4	6.4	3	12	2	7.9	2	6.4	4	ND	2
S2	5	11	1988	DRY	2	ND	6	ND	6	ND	10	ND	5	13	10	ND	5
S2	8	22	1988	DRY	3	ND	10	ND	10	ND	10	ND	5	ND	10	ND	10
S2	12	12	1988	DRY	4	ND	8	ND	8	ND	8	8.4	4	ND	8	ND	4
S3	3	30	1988	DRY	1	ND	4	28	3	22	2	26	2	26	4	ND	2
S3	5	11	1988	DRY	2	ND	6	ND	6	ND	10	ND	5	11	10	ND	5
S3	8	22	1988	DRY	3	13	10	10	10	27	10	8.1	5	37	10	ND	10
S3	12	12	1988	DRY	4	20	8	13	8	24	8	13	4	25	8	ND	4
S3FD	8	22	1988	DRY	3	13	10	10	10	22	10	8.6	5	27	10	ND	10
S3FD	12	12	1988	DRY	4	16	8	9.8	8	17	8	11	4	ND	8	ND	4
S4	3	30	1988	DRY	1	13	4	8.4	3	24	2	14	2	8.9	4	ND	2
S4	5	11	1988	DRY	2	ND	6	ND	6	ND	10	ND	5	ND	10	ND	5
S4	8	22	1988	DRY	3	13	10	10	10	31	10	12	5	28	10	ND	10
S4	12	12	1988	DRY	4	20	8	14	8	34	8	26	4	ND	8	ND	4
S4LR	3	30	1988	DRY	1	ND	4	3.5	3	7	2	8.5	2	11	4	ND	2

Sample	Date Sampled			Sample	Sample	ENDOSLFN-A		ENDOSLFN-B		ENDOSLFN-S		ENDRIN		ENDRIN-ALD	
I.D.	Month	Day	Year	Type	Event	actual µg/kg	D.L. µg/kg	actual µg/kg	D.L. µg/kg	actual µg/kg	D.L. µg/kg	actual µg/kg	D.L. µg/kg	actual µg/kg	D.L. µg/kg
STANDARD REPORTING OBJECTIVES							2		2		4		4		4
S1	3	30	1988	DRY	1	ND	2	ND	2	ND	4	ND	4	ND	4
S1	5	11	1988	DRY	2	ND	5	ND	5	ND	10	ND	10	ND	10
S1	8	22	1988	DRY	3	ND	5	ND	10	ND	10	ND	10	ND	10
S1	12	12	1988	DRY	4	ND	4	ND	4	ND	8	ND	8	ND	8
S2	3	30	1988	DRY	1	ND	2	3.4	2	ND	4	ND	4	ND	4
S2	5	11	1988	DRY	2	ND	5	ND	5	ND	10	ND	10	ND	10
S2	8	22	1988	DRY	3	ND	5	ND	10	ND	10	ND	10	ND	10
S2	12	12	1988	DRY	4	ND	4	ND	4	ND	8	ND	8	ND	8
S3	3	30	1988	DRY	1	ND	2	9	2	ND	4	ND	4	ND	4
S3	5	11	1988	DRY	2	ND	5	ND	5	ND	10	ND	10	ND	10
S3	8	22	1988	DRY	3	ND	5	ND	10	ND	10	ND	10	ND	10
S3	12	12	1988	DRY	4	ND	4	ND	4	ND	8	ND	8	ND	8
S3FD	8	22	1988	DRY	3	ND	5	ND	10	ND	10	ND	10	ND	10
S3FD	12	12	1988	DRY	4	ND	4	ND	4	ND	8	ND	8	ND	8
S4	3	30	1988	DRY	1	ND	2	ND	2	ND	4	ND	4	ND	4
S4	5	11	1988	DRY	2	ND	5	ND	5	ND	10	ND	10	ND	10
S4	8	22	1988	DRY	3	ND	5	ND	10	ND	10	ND	10	ND	10
S4	12	12	1988	DRY	4	ND	4	ND	4	ND	8	ND	8	ND	8
S4LR	3	30	1988	DRY	1	ND	2	ND	2	ND	4	ND	4	ND	4

Sample I.D.	Date Sampled			Sample Type	Sample Event	HEPTACHLOR		HEPCL EPOX		METHOXYCL		TOXAPHENE		tPCB	
	Month	Day	Year			actual µg/kg	D.L. µg/kg	actual µg/kg	D.L. µg/kg	actual µg/kg	D.L. µg/kg	actual µg/kg	D.L. µg/kg	actual µg/kg	D.L. µg/kg
STANDARD REPORTING OBJECTIVES							2		22		2		20		20
S1	3	30	1988	DRY	1	ND	2	ND	22	ND	2	ND	20	ND	20
S1	5	11	1988	DRY	2	ND	5	ND	5	ND	5	ND	100	ND	100
S1	8	22	1988	DRY	3	ND	5	ND	5	ND	50	ND	100	ND	100
S1	12	12	1988	DRY	4	ND	4	ND	4	ND	40	ND	80	140	80
S2	3	30	1988	DRY	1	ND	2	ND	22	ND	2	ND	20	ND	20
S2	5	11	1988	DRY	2	ND	5	ND	5	ND	5	ND	100	ND	100
S2	8	22	1988	DRY	3	ND	5	ND	5	ND	50	ND	100	ND	100
S2	12	12	1988	DRY	4	ND	4	ND	4	ND	40	ND	80	ND	80
S3	3	30	1988	DRY	1	ND	2	ND	22	ND	2	ND	20	390	20
S3	5	11	1988	DRY	2	ND	5	ND	5	ND	5	ND	100	ND	100
S3	8	22	1988	DRY	3	ND	5	ND	5	ND	50	ND	100	ND	100
S3	12	12	1988	DRY	4	ND	4	ND	4	ND	40	ND	80	240	80
S3FD	8	22	1988	DRY	3	ND	5	ND	5	ND	50	ND	100	ND	100
S3FD	12	12	1988	DRY	4	ND	4	ND	4	ND	40	ND	80	125	80
S4	3	30	1988	DRY	1	ND	2	ND	22	ND	2	ND	20	80	20
S4	5	11	1988	DRY	2	ND	5	ND	5	ND	5	ND	100	ND	100
S4	8	22	1988	DRY	3	ND	5	ND	5	ND	50	ND	100	ND	100
S4	12	12	1988	DRY	4	ND	4	ND	4	ND	40	ND	80	ND	80
S4LR	3	30	1988	DRY	1	ND	2	ND	22	ND	2	ND	20	44	20

D.4 Chlorinated herbicides

D.4-1 Chlorinated herbicides and TOX in water column

Sample I.D.	Date Sampled Month	Day	Year	Sample Type	Sample Event	TOX actual mg/l	TOX D.L. mg/l	2,4,5-T actual ug/l	2,4,5-T D.L. ug/l	SILVEX actual ug/l	SILVEX D.L. ug/l	2,4,D actual ug/l	2,4,D D.L. ug/l	2,4,DB actual ug/l	2,4,DB D.L. ug/l	DALAPON actual ug/l	DALAPON D.L. ug/l
STANDARD REPORTING LIMITS							0.025		1		1		5		10		500
L1	4	20	1988	WET	1	0.058	0.025	ND	1	ND	1	ND	5	ND	10	ND	500
L1	11	23	1988	WET	2	0.065	0.025	ND	1	ND	1	ND	5	ND	10	ND	500
L1	2	4	1989	WET	4	0.06	0.025										
L1	2	9	1989	WET	5	0.06	0.025										
L1LR	2	9	1989	WET	5	0.04	0.025										
L1	3	2	1989	WET	6		0.025										
L1LR	3	2	1989	WET	6	ND	0.025										
L2	4	20	1988	WET	1	0.048	0.025	ND	1	ND	1	ND	5	ND	10	ND	500
L2	11	23	1988	WET	2	0.033	0.025	ND	1	ND	1	ND	5	ND	10	ND	500
L2	2	4	1989	WET	4	ND	0.025										
L2	2	9	1989	WET	5	ND	0.025										
L3	4	20	1988	WET	1	0.042	0.025	ND	1	ND	1	ND	5	ND	10	ND	500
L3	11	23	1988	WET	2	0.038	0.025	ND	1	ND	1	ND	5	ND	10	ND	500
L3	2	4	1989	WET	4	ND	0.025										
L3	2	9	1989	WET	5	ND	0.025										
L3	3	2	1989	WET	6	ND	0.025										
L4	2	4	1989	WET	4	0.04	0.025										
L4	2	9	1989	WET	5	0.04	0.025										
L5	11	23	1988	WET	2	0.045	0.025	ND	1	ND	1	ND	5	ND	10	ND	500
L5	1	23	1989	WET	3	0.03	0.025										
L5	2	4	1989	WET	4	ND	0.025										
L5LR	2	4	1989	WET	4	ND	0.025										
L5FD	2	4	1989	WET	4	ND	0.025										
L5	2	9	1989	WET	5	0.03	0.025										
L5	3	2	1989	WET	6	ND	0.025										
L5FD	3	2	1989	WET	6	ND	0.025										
L6	4	20	1988	WET	1	0.051	0.025	ND	1	ND	1	ND	5	ND	10	ND	500
L6	11	23	1988	WET	2	0.028	0.025	ND	1	ND	1	ND	5	ND	10	ND	500
L6	2	9	1989	WET	5	ND	0.025										
L7	11	23	1988	WET	2	ND	0.025	ND	1	ND	1	ND	5	ND	10	ND	500
L7	2	4	1989	WET	4	ND	0.025										
L7	2	9	1989	WET	5	ND	0.025										
L7	3	2	1989	WET	6	ND	0.025										
R1	2	27	1988	RES	1	ND	0.025	ND	0.5	ND	0.5	ND	3	ND	5	ND	250
R2	2	26	1988	RES	1	ND	0.025	ND	0.5	ND	0.5	ND	3	ND	5	ND	250
R3	2	27	1988	RES	1	ND	0.025	ND	0.5	ND	0.5	ND	3	ND	5	ND	250
R4	2	27	1988	RES	1	ND	0.025	ND	0.5	ND	0.5	ND	3	ND	5	ND	250
R5	2	27	1988	RES	1	ND	0.025	ND	0.5	ND	0.5	ND	3	ND	5	ND	250
R6	2	27	1988	RES	1	ND	0.025	ND	0.5	ND	0.5	ND	3	ND	5	ND	250

						TOX		2,4,5-T		SILVEX		2,4,D		2,4,DB		DALAPON	
Sample I.D.	Date Sampled Month	Day	Year	Sample Type	Sample Event	actual mg/l	D.L. mg/l	actual ug/l	D.L. ug/l	actual ug/l	D.L. ug/l	actual ug/l	D.L. ug/l	actual ug/l	D.L. ug/l	actual ug/l	D.L. ug/l
S1	2	26	1988	DRY	1	0.08	0.025	ND	0.5	ND	0.5	13	3	ND	5	ND	250
S1FD1	2	26	1988	DRY	1	0.08	0.025	ND	0.5	ND	0.5	13	3	ND	5	ND	250
S1FD2	2	26	1988	DRY	1	0.08	0.025	ND	0.5	ND	0.5	11	3	ND	5	ND	250
S1	3	30	1988	DRY	2			ND	0.1	ND	0.1	ND	0.5	ND	1	ND	50
S1FD	3	30	1988	DRY	2			ND	0.1	ND	0.1	ND	0.5	ND	1	ND	50
S1	5	11	1988	DRY	3			ND	2	ND	2	ND	10	ND	20	ND	1000
S1	12	12	1988	DRY	5	0.12	0.025	ND	1	ND	1	ND	5	ND	10	ND	500
S1	2	1	1989	DRY	6	0.11	0.025										
S1	4	6	1989	DRY	7	0.09	0.025										
S1	11	23	1988	WET	2	0.042	0.025	ND	1	ND	1	ND	5	ND	10	ND	500
S1	1	23	1989	WET	3	0.10	0.025										
S1	2	4	1989	WET	4	0.03	0.025										
S1	2	9	1989	WET	5	ND	0.025										
S1FD	2	9	1989	WET	5	ND	0.025										
S1	3	2	1989	WET	6	ND	0.025										
S2	2	26	1988	DRY	1	ND	0.025	ND	0.5	ND	0.5	ND	3	ND	5	ND	250
S2	3	30	1988	DRY	2			ND	0.1	ND	0.1	ND	0.5	ND	1	ND	50
S2	5	11	1988	DRY	3			ND	1	ND	1	ND	5	ND	10	ND	500
S2	12	12	1988	DRY	5	ND	0.025	ND	1	ND	1	ND	5	ND	10	ND	500
S2	2	1	1989	DRY	6	ND	0.025										
S2	4	6	1989	DRY	7	ND	0.025										
S2	11	23	1988	WET	2	0.053	0.025	ND	1	ND	1	ND	5	ND	10	ND	500
S2	1	23	1989	WET	3	0.04	0.025										
S2FD	1	23	1989	WET	3	0.04	0.025										
S2	2	4	1989	WET	4	0.03	0.025										
S2	2	9	1989	WET	5	ND	0.025										
S2	3	2	1989	WET	6	ND	0.025										
S3	2	26	1988	DRY	1	ND	0.025	ND	0.5	ND	0.5	ND	3	ND	5	ND	250
S3	3	30	1988	DRY	2			ND	0.1	ND	0.1	ND	0.5	ND	1	ND	50
S3	5	11	1988	DRY	3			ND	1	ND	1	ND	5	ND	10	ND	500
S3	8	22	1988	DRY	4	ND	0.025	ND	1	ND	1	ND	5	ND	10	ND	500
S3FD	8	22	1988	DRY	4	ND	0.025	ND	1	ND	1	ND	5	ND	10	ND	500
S3	12	12	1988	DRY	5	ND	0.025	ND	1	ND	1	ND	5	ND	10	ND	500
S3	2	1	1989	DRY	6	ND	0.025										
S3LR	2	1	1989	DRY	6	ND	0.025										
S3FD	2	1	1989	DRY	6	ND	0.025										
S3	4	6	1989	DRY	7	ND	0.025										
S3LR	4	6	1989	DRY	7	ND	0.025										
S3FD	4	6	1989	DRY	7	ND	0.025										
S3	4	20	1988	WET	1			ND	1	ND	1	ND	5	ND	10	ND	500
S3	11	23	1988	WET	2	0.029	0.025	ND	1	ND	1	ND	5	ND	10	ND	500
S3FD	11	23	1988	WET	2	0.055	0.025	ND	1	ND	1	ND	5	ND	10	ND	500
S3LR	11	23	1988	WET	2	0.036	0.025	ND	1	ND	1	ND	5	ND	10	ND	500
S3	1	23	1989	WET	3	ND	0.025										

S3LR	1	23	1989	WET	3	ND	0.025
S3	2	4	1989	WET	4	ND	0.025
S3	2	9	1989	WET	5	ND	0.025
S3	3	2	1989	WET	6	ND	0.025

						TOX		2,4,5-T		SILVEX		2,4,D		2,4,DB		DALAPON	
Sample I.D.	Date Sampled Month	Day	Year	Sample Type	Sample Event	actual mg/l	D.L. mg/l	actual ug/l	D.L. ug/l	actual ug/l	D.L. ug/l	actual ug/l	D.L. ug/l	actual ug/l	D.L. ug/l	actual ug/l	D.L. ug/l
STANDARD REPORTING LIMITS							0.025		1		1		5		10		500
S4	2	26	1988	DRY	1	0.03	0.025	ND	0.5	ND	0.5	6.5	3	ND	5	ND	250
S4	3	30	1988	DRY	2			ND	0.1	ND	0.1	ND	0.5	ND	1	ND	50
S4	5	11	1988	DRY	3			ND	1	ND	1	61	5	ND	10	ND	500
S4	8	22	1988	DRY	4	ND	0.025	ND	1	ND	1	ND	5	ND	10	ND	500
S4	12	12	1988	DRY	5	ND	0.025	ND	1	ND	1	ND	5	ND	10	ND	500
S4FD	12	12	1988	DRY	5	ND	0.025	ND	1	ND	1	ND	5	ND	10	ND	500
S4FDLR	12	12	1988	DRY	5	ND	0.025	ND	1	ND	1	ND	5	ND	10	ND	500
S4	2	1	1989	DRY	6	0.03	0.025										
S4	4	6	1989	DRY	7	0.05	0.025										
S4D	5	11	1988	DRY	3			ND	1	ND	1	56	5	ND	10	ND	500
S4	4	20	1988	WET	1	0.029	0.025	ND	1	ND	1	ND	5	ND	10	ND	500
S4	11	23	1988	WET	2	0.028	0.025	ND	1	ND	1	ND	5	ND	10	ND	500
S4	2	4	1989	WET	4	ND	0.025										
S4	2	9	1989	WET	5	0.03	0.025										
5B	2	1	1989	DRY	6	ND	0.025										
5B	1	23	1989	WET	3	0.04	0.025										
5B	2	4	1989	WET	4	ND	0.025										
5B	2	9	1989	WET	5	0.05	0.025										
FB	8	22	1988	DRY	4	ND	0.025	ND	1	ND	1	ND	5	ND	10	ND	500
FB	12	12	1988	DRY	5	ND	0.025	ND	1	ND	1	ND	5	ND	10	ND	500
FB	4	6	1989	DRY	7	ND	0.025										
FB	11	23	1988	WET	2	ND	0.025	ND	1	ND	1	ND	5	ND	10	ND	500
FB	3	2	1989	WET	6	ND	0.025										

						DICAMBA		DICHLOROPROP		DINOSEB		MCPA		MCPP	
Sample I.D.	Date Sampled Month	Day	Year	Sample Type	Sample Event	actual ug/l	D.L. ug/l	actual ug/l	D.L. ug/l	actual ug/l	D.L. ug/l	actual ug/l	D.L. ug/l	actual ug/l	D.L. ug/l
STANDARD REPORTING LIMITS							5		5		5		2000		2000
L1	4	20	1988	WET	1	ND	5	ND	5	ND	5	ND	2000	ND	2000
L1	11	23	1988	WET	2	ND	5	ND	5	ND	5	ND	2000	ND	2000
L1	2	4	1989	WET	4										
L1	2	9	1989	WET	5										
L1LR	2	9	1989	WET	5										
L1	3	2	1989	WET	6										
L1LR	3	2	1989	WET	6										
L2	4	20	1988	WET	1	ND	5	ND	5	ND	5	ND	2000	ND	2000
L2	11	23	1988	WET	2	ND	5	ND	5	ND	5	ND	2000	ND	2000
L2	2	4	1989	WET	4										
L2	2	9	1989	WET	5										
L3	4	20	1988	WET	1	ND	5	ND	5	ND	5	ND	2000	ND	2000
L3	11	23	1988	WET	2	ND	5	ND	5	ND	5	ND	2000	ND	2000
L3	2	4	1989	WET	4										
L3	2	9	1989	WET	5										
L3	3	2	1989	WET	6										
L4	2	4	1989	WET	4										
L4	2	9	1989	WET	5										
L5	11	23	1988	WET	2	ND	5	ND	5	ND	5	ND	2000	ND	2000
L5	1	23	1989	WET	3										
L5	2	4	1989	WET	4										
L5LR	2	4	1989	WET	4										
L5FD	2	4	1989	WET	4										
L5	2	9	1989	WET	5										
L5	3	2	1989	WET	6										
L5FD	3	2	1989	WET	6										
L6	4	20	1988	WET	1	ND	5	ND	5	ND	5	ND	2000	ND	2000
L6	11	23	1988	WET	2	ND	5	ND	5	ND	5	ND	2000	ND	2000
L6	2	9	1989	WET	5										
L7	11	23	1988	WET	2	ND	5	ND	5	ND	5	ND	2000	ND	2000
L7	2	4	1989	WET	4										
L7	2	9	1989	WET	5										
L7	3	2	1989	WET	6										
R1	2	27	1988	RES	1	ND	3	ND	3	ND	3	ND	1000	ND	1000
R2	2	26	1988	RES	1	ND	3	ND	3	ND	3	ND	1000	ND	1000
R3	2	27	1988	RES	1	ND	3	ND	3	ND	3	ND	1000	ND	1000
R4	2	27	1988	RES	1	ND	3	ND	3	ND	3	ND	1000	ND	1000
R5	2	27	1988	RES	1	ND	3	ND	3	ND	3	ND	1000	ND	1000
R6	2	27	1988	RES	1	ND	3	ND	3	ND	3	ND	1000	ND	1000

Sample I.D.	Date Sampled Month	Day	Year	Sample Type	Sample Event	DICAMBA actual ug/l	D.L. ug/l	DICHLOROPROP actual ug/l	D.L. ug/l	DINOSEB actual ug/l	D.L. ug/l	MCPA actual ug/l	D.L. ug/l	MCPP actual ug/l	D.L. ug/l
S1	2	26	1988	DRY	1	5.1	3	ND	3	ND	3	ND	1000	ND	1000
S1FD1	2	26	1988	DRY	1	4.9	3	ND	3	ND	3	ND	1000	ND	1000
S1FD2	2	26	1988	DRY	1	4.2	3	ND	3	ND	3	ND	1000	ND	1000
S1	3	30	1988	DRY	2	ND	0.5	ND	0.5	ND	0.5	ND	200	ND	200
S1FD	3	30	1988	DRY	2	ND	0.5	ND	0.5	ND	0.5	ND	200	ND	200
S1	5	11	1988	DRY	3	ND	10	ND	10	ND	10	ND	4000	ND	4000
S1	12	12	1988	DRY	5	ND	5	ND	5	ND	5	ND	2000	ND	2000
S1	2	1	1989	DRY	6										
S1	4	6	1989	DRY	7										
S1	11	23	1988	WET	2	ND	5	ND	5	ND	5	ND	2000	ND	2000
S1	1	23	1989	WET	3										
S1	2	4	1989	WET	4										
S1	2	9	1989	WET	5										
S1FD	2	9	1989	WET	5										
S1	3	2	1989	WET	6										
S2	2	26	1988	DRY	1	ND	3	ND	3	ND	3	ND	1000	ND	1000
S2	3	30	1988	DRY	2	ND	0.5	ND	0.5	ND	0.5	ND	200	ND	200
S2	5	11	1988	DRY	3	ND	5	ND	5	ND	5	ND	2000	ND	2000
S2	12	12	1988	DRY	5	ND	5	ND	5	ND	5	ND	2000	ND	2000
S2	2	1	1989	DRY	6										
S2	4	6	1989	DRY	7										
S2	11	23	1988	WET	2	ND	5	ND	5	ND	5	ND	2000	ND	2000
S2	1	23	1989	WET	3										
S2FD	1	23	1989	WET	3										
S2	2	4	1989	WET	4										
S2	2	9	1989	WET	5										
S2	3	2	1989	WET	6										
S3	2	26	1988	DRY	1	ND	3	ND	3	ND	3	ND	1000	ND	1000
S3	3	30	1988	DRY	2	ND	0.5	ND	0.5	ND	0.5	ND	200	ND	200
S3	5	11	1988	DRY	3	ND	5	ND	5	ND	5	ND	2000	ND	2000
S3	8	22	1988	DRY	4	ND	5	ND	5	ND	5	ND	2000	ND	2000
S3FD	8	22	1988	DRY	4	ND	5	ND	5	ND	5	ND	2000	ND	2000
S3	12	12	1988	DRY	5	ND	5	ND	5	ND	5	ND	2000	ND	2000
S3	2	1	1989	DRY	6										
S3LR	2	1	1989	DRY	6										
S3FD	2	1	1989	DRY	6										
S3	4	6	1989	DRY	7										
S3LR	4	6	1989	DRY	7										
S3FD	4	6	1989	DRY	7										
S3	4	20	1988	WET	1	ND	5	ND	5	ND	5	ND	2000	ND	2000
S3	11	23	1988	WET	2	ND	5	ND	5	ND	5	ND	2000	ND	2000
S3FD	11	23	1988	WET	2	ND	5	ND	5	ND	5	ND	2000	ND	2000
S3LR	11	23	1988	WET	2	ND	5	ND	5	ND	5	ND	2000	ND	2000
S3	1	23	1989	WET	3										

S3LR	1	23	1989	WET	3
S3	2	4	1989	WET	4
S3	2	9	1989	WET	5
S3	3	2	1989	WET	6

						DICAMBA		DICHLOROPROP		DINOSEB		MCPA		MCPP	
Sample I.D.	Date Sampled Month	Day	Year	Sample Type	Sample Event	actual ug/l	D.L. ug/l	actual ug/l	D.L. ug/l	actual ug/l	D.L. ug/l	actual ug/l	D.L. ug/l	actual ug/l	D.L. ug/l
STANDARD REPORTING LIMITS							5		5		5		2000		2000
S4	2	26	1988	DRY	1	ND	3	ND	3	ND	3	ND	1000	ND	1000
S4	3	30	1988	DRY	2	ND	0.5	ND	0.5	ND	0.5	ND	200	ND	200
S4	5	11	1988	DRY	3	47	5	ND	5	ND	5	ND	2000	ND	2000
S4	8	22	1988	DRY	4	ND	5	ND	5	ND	5	ND	2000	ND	2000
S4	12	12	1988	DRY	5	ND	5	ND	5	ND	5	ND	2000	ND	2000
S4FD	12	12	1988	DRY	5	ND	5	ND	5	ND	5	ND	2000	ND	2000
S4FDLR	12	12	1988	DRY	5	ND	5	ND	5	ND	5	ND	2000	ND	2000
S4	2	1	1989	DRY	6										
S4	4	6	1989	DRY	7										
S4D	5	11	1988	DRY	3	48	5	ND	5	ND	5	ND	2000	ND	2000
S4	4	20	1988	WET	1	ND	5	ND	5	ND	5	ND	2000	ND	2000
S4	11	23	1988	WET	2	ND	5	ND	5	ND	5	ND	2000	ND	2000
S4	2	4	1989	WET	4										
S4	2	9	1989	WET	5										
5B	2	1	1989	DRY	6										
5B	1	23	1989	WET	3										
5B	2	4	1989	WET	4										
5B	2	9	1989	WET	5										
FB	8	22	1988	DRY	4	ND	5	ND	5	ND	5	ND	2000	ND	2000
FB	12	12	1988	DRY	5	ND	5	ND	5	ND	5	ND	2000	ND	2000
FB	4	6	1989	DRY	7										
FB	11	23	1988	WET	2	ND	5	ND	5	ND	5	ND	2000	ND	2000
FB	3	2	1989	WET	6										

D.4-2 Chlorinated herbicides in sediment

Sample I.D.	Date Sampled Month	Day	Year	Sample Type	Sample Event	2,4,5-T actual mg/kg	2,4,5-T D.L. mg/kg	SILVEX actual mg/kg	SILVEX D.L. mg/kg	2,4,D actual mg/kg	2,4,D D.L. mg/kg	2,4,DB actual mg/kg	2,4,DB D.L. mg/kg	DALAPON actual mg/kg	DALAPON D.L. mg/kg
STANDARD REPORTING OBJECTIVES							0.1		0.1		0.6		1		1
S1	3	30	1988	DRY	1	ND	0.05	ND	0.05	ND	0.3	ND	0.5		
S1	5	11	1988	DRY	2	ND	0.1	ND	0.1	ND	0.6	ND	1		
S1	8	22	1988	DRY	3	ND	0.1	ND	0.1	ND	0.6	ND	1	ND	1
S1LR	8	22	1988	DRY	3	ND	0.1	ND	0.1	ND	0.6	ND	1	ND	1
S1	12	12	1988	DRY	4	ND	0.1	ND	0.1	ND	0.6	ND	1	ND	50
S2	3	30	1988	DRY	1	ND	0.05	ND	0.05	ND	0.3	ND	0.5		
S2	5	11	1988	DRY	2	ND	0.1	ND	0.1	ND	0.6	ND	1		
S2	8	22	1988	DRY	3	ND	0.1	ND	0.1	ND	0.6	ND	1	ND	1
S2	12	12	1988	DRY	4	ND	0.1	ND	0.1	ND	0.6	ND	1	ND	50
S3	3	30	1988	DRY	1	ND	0.05	ND	0.05	ND	0.3	ND	0.5		
S3	5	11	1988	DRY	2	ND	0.1	ND	0.1	ND	0.6	ND	1		
S3	8	22	1988	DRY	3	ND	0.1	ND	0.1	ND	0.6	ND	1	ND	1
S3FD	8	22	1988	DRY	3	ND	0.1	ND	0.1	ND	0.6	ND	1	ND	1
S3	12	12	1988	DRY	4	ND	0.1	ND	0.1	ND	0.6	ND	1	ND	50
S3FD	12	12	1988	DRY	4	ND	0.1	ND	0.1	ND	0.6	ND	1	ND	50
S4	3	30	1988	DRY	1	ND	0.05	ND	0.05	ND	0.3	ND	0.5		
S4	5	11	1988	DRY	2	ND	0.1	ND	0.1	ND	0.6	ND	1		
S4FD	5	11	1988	DRY	2	ND	0.1	ND	0.1	ND	0.6	ND	1		
S4	8	22	1988	DRY	3	ND	0.1	ND	0.1	ND	0.6	ND	1	ND	1
S4	12	12	1988	DRY	4	ND	0.1	ND	0.1	ND	0.6	ND	1	ND	50

Sample I.D.	Date Sampled			Sample Type	Sample Event	DICHLOROPROP		DINOSEB		MCPA		MCPP	
	Month	Day	Year			actual mg/kg	D.L. mg/kg	actual mg/kg	D.L. mg/kg	actual mg/kg	D.L. mg/kg	actual mg/kg	D.L. mg/kg
STANDARD REPORTING OBJECTIVES							0.6		0.6		200		200
S1	3	30	1988	DRY	1	ND	0.3	ND	0.3	ND	100	ND	100
S1	5	11	1988	DRY	2	ND	0.6	ND	0.6	ND	200	ND	200
S1	8	22	1988	DRY	3	ND	0.6	ND	0.6	ND	200	ND	200
S1LR	8	22	1988	DRY	3	ND	0.6	ND	0.6	ND	200	ND	200
S1	12	12	1988	DRY	4	ND	0.6	ND	0.6	ND	200	ND	200
S2	3	30	1988	DRY	1	ND	0.3	ND	0.3	ND	100	ND	100
S2	5	11	1988	DRY	2	ND	0.6	ND	0.6	ND	200	ND	200
S2	8	22	1988	DRY	3	ND	0.6	ND	0.6	ND	200	ND	200
S2	12	12	1988	DRY	4	ND	0.6	ND	0.6	ND	200	ND	200
S3	3	30	1988	DRY	1	ND	0.3	ND	0.3	ND	100	ND	100
S3	5	11	1988	DRY	2	ND	0.6	ND	0.6	ND	200	ND	200
S3	8	22	1988	DRY	3	ND	0.6	ND	0.6	ND	200	ND	200
S3FD	8	22	1988	DRY	3	ND	0.6	ND	0.6	ND	200	ND	200
S3	12	12	1988	DRY	4	ND	0.6	ND	0.6	ND	200	ND	200
S3FD	12	12	1988	DRY	4	ND	0.6	ND	0.6	ND	200	ND	200
S4	3	30	1988	DRY	1	ND	0.3	ND	0.3	ND	100	ND	100
S4	5	11	1988	DRY	2	ND	0.6	ND	0.6	ND	200	ND	200
S4FD	5	11	1988	DRY	2	ND	0.6	ND	0.6	ND	200	ND	200
S4	8	22	1988	DRY	3	ND	0.6	ND	0.6	ND	200	ND	200
S4	12	12	1988	DRY	4	ND	0.6	ND	0.6	ND	200	ND	200

D.5 Organophosphate pesticides

D.5-1 Organophosphate pesticides in water column

	Date Sampled					AZINPHOS-METHYL		CHLORPYRIFOS		COUMAPHOS		DDVP		DEMETON	
Sample I.D.	Month	Day	Year	Sample Type	Sample Event	actual ug/l	D.L. ug/l	actual ug/l	D.L. ug/l	actual ug/l	D.L. ug/l	actual ug/l	D.L. ug/l	actual ug/l	D.L. ug/l
STANDARD REPORTING LIMITS							0.5		0.05		0.5		0.05		0.05
S1	3	30	1988	DRY	2	ND	2	ND	0.5	ND	2	ND	1	ND	1
S1LR	3	30	1988	DRY	2	ND	2	ND	0.5	ND	2	ND	1	ND	1
S2	3	30	1988	DRY	2	ND	2	ND	0.5	ND	2	ND	1	ND	1
S3	3	30	1988	DRY	2	ND	2	ND	0.5	ND	2	ND	1	ND	1
S4	3	30	1988	DRY	2	ND	2	ND	0.5	ND	2	ND	1	ND	1

Sample	Date Sampled			Sample	Sample	DIAZINON		DIMETHOATE		DISULFOTON		EPN		ETHOPROP		FENSULFOTHION	
I.D.	Month	Day	Year	Type	Event	actual ug/l	D.L. ug/l	actual ug/l	D.L. ug/l	actual ug/l	D.L. ug/l	actual ug/l	D.L. ug/l	actual ug/l	D.L. ug/l	actual ug/l	D.L. ug/l
STANDARD REPORTING LIMITS							0.05		0.05		0.05		0.05		0.05		0.05
S1	3	30	1988	DRY	2	ND	0.5	ND	0.5	ND	0.5	ND	0.5	ND	0.5	ND	1
S1LR	3	30	1988	DRY	2	ND	0.5	ND	0.5	ND	0.5	ND	0.5	ND	0.5	ND	1
S2	3	30	1988	DRY	2	ND	0.5	ND	0.5	ND	0.5	ND	0.5	ND	0.5	ND	1
S3	3	30	1988	DRY	2	ND	0.5	ND	0.5	ND	0.5	ND	0.5	ND	0.5	ND	1
S4	3	30	1988	DRY	2	ND	0.5	ND	0.5	ND	0.5	ND	0.5	ND	0.5	ND	1

Sample I.D.	Date Sampled			Sample Type	Sample Event	FENTHION		MALATHION		MERPHOS		MEVINPHOS		MONOCROTOPHOS	
	Month	Day	Year			actual ug/l	D.L. ug/l	actual ug/l	D.L. ug/l	actual ug/l	D.L. ug/l	actual ug/l	D.L. ug/l	actual ug/l	D.L. ug/l
STANDARD REPORTING LIMITS							0.1		0.05		0.05		0.05		0.05
S1	3	30	1988	DRY	2	ND	0.5	ND	1	NA	0.05	ND	1	ND	1
S1LR	3	30	1988	DRY	2	ND	0.5	ND	1	NA	0.05	ND	1	ND	1
S2	3	30	1988	DRY	2	ND	0.5	ND	1	NA	0.05	ND	1	ND	1
S3	3	30	1988	DRY	2	ND	0.5	ND	1	NA	0.05	ND	1	ND	1
S4	3	30	1988	DRY	2	ND	0.5	ND	1	NA	0.05	ND	1	ND	1

Sample I.D.	Date Sampled Month	Day	Year	Sample Type	Sample Event	NALED actual ug/l	NALED D.L. ug/l	PARATHION, ETH actual ug/l	PARATHION, ETH D.L. ug/l	PARATHION, METH actual ug/l	PARATHION, METH D.L. ug/l	PHORATE actual ug/l	PHORATE D.L. ug/l	RONNEL actual ug/l	RONNEL D.L. ug/l
STANDARD REPORTING LIMITS							0.05		0.2		0.1		0.05		0.05
S1	3	30	1988	DRY	2	ND	5	ND	0.5	ND	0.5	ND	0.5	NA	1
S1LR	3	30	1988	DRY	2	ND	5	ND	0.5	ND	0.5	ND	0.5	NA	1
S2	3	30	1988	DRY	2	ND	5	ND	0.5	ND	0.5	ND	0.5	NA	1
S3	3	30	1988	DRY	2	ND	5	ND	0.5	ND	0.5	ND	0.5	NA	1
S4	3	30	1988	DRY	2	ND	5	ND	0.5	ND	0.5	ND	0.5	NA	1

Sample I.D.	Date Sampled			Sample Type	Sample Event	SULFOTEPP		SULPROFOS		TEPP		TETRACHLORVINPHOS	
	Month	Day	Year			actual ug/l	D.L. ug/l	actual ug/l	D.L. ug/l	actual ug/l	D.L. ug/l	actual ug/l	D.L. ug/l
STANDARD REPORTING LIMITS							0.05		0.05		0.1		0.02
S1	3	30	1988	DRY	2	ND	0.5	ND	0.5	ND	10	ND	2
S1LR	3	30	1988	DRY	2	ND	0.5	ND	0.5	ND	10	ND	2
S2	3	30	1988	DRY	2	ND	0.5	ND	0.5	ND	10	ND	2
S3	3	30	1988	DRY	2	ND	0.5	ND	0.5	ND	10	ND	2
S4	3	30	1988	DRY	2	ND	0.5	ND	0.5	ND	10	ND	2

Sample I.D.	Date Sampled Month	Day	Year	Sample Type	Sample Event	TRICHLORONATE actual ug/l	D.L. ug/l
STANDARD REPORTING LIMITS							0.05
S1	3	30	1988	DRY	2	NA	0.5
S1LR	3	30	1988	DRY	2	NA	0.5
S2	3	30	1988	DRY	2	NA	0.5
S3	3	30	1988	DRY	2	NA	0.5
S4	3	30	1988	DRY	2	NA	0.5

D.5-2 Organophosphate pesticides in sediment

	Date Sampled					AZINPHOS-METHYL		CHLORPYRIFOS		COUMAPHOS		DDVP		DEMETON		DIAZINON	
Sample I.D.	Month	Day	Year	Sample Type	Sample Event	actual mg/kg	D.L. mg/kg	actual mg/kg	D.L. mg/kg	actual mg/kg	D.L. mg/kg	actual mg/kg	D.L. mg/kg	actual mg/kg	D.L. mg/kg	actual mg/kg	D.L. mg/kg
							0.1		0.01		0.1		0.01		0.01		0.01
STANDARD REPORTING OBJECTIVES																	
S1	8	22	1988	DRY	3												
S2	8	22	1988	DRY	3	ND	2.5	ND	0.25	ND	1.25	ND	0.25	ND	0.25	ND	0.25
S3	8	22	1988	DRY	3	ND	1	ND	0.1	ND	0.5	ND	0.1	ND	0.1	ND	0.1
S3LR	8	22	1988	DRY	3	ND	1	ND	0.1	ND	0.5	ND	0.1	ND	0.1	ND	0.1
S4	8	22	1988	DRY	3	ND	1	ND	0.1	ND	0.5	ND	0.1	ND	0.1	ND	0.1
S3FD	8	22	1988	DRY	3	ND	1	ND	0.1	ND	0.5	ND	0.1	ND	0.1	ND	0.1

	Date Sampled					DIMETHOATE		DISULFOTON		EPN		ETHOPROP		FENSULFOTHION		FENTHION	
Sample I.D.	Month	Day	Year	Sample Type	Sample Event	actual mg/kg	D.L. mg/kg	actual mg/kg	D.L. mg/kg	actual mg/kg	D.L. mg/kg	actual mg/kg	D.L. mg/kg	actual mg/kg	D.L. mg/kg	actual mg/kg	D.L. mg/kg
STANDARD REPORTING OBJECTIVES							0.01		0.01		0.01		0.01		0.01		0
S1	8	22	1988	DRY	3												
S2	8	22	1988	DRY	3	ND	0.25	ND	0.25	ND	0.25	ND	0.25	ND	0.5	ND	0
S3	8	22	1988	DRY	3	ND	0.1	ND	0.1	ND	0.1	ND	0.1	ND	0.2	ND	0
S3LR	8	22	1988	DRY	3	ND	0.1	ND	0.1	ND	0.1	ND	0.1	ND	0.2	ND	0
S4	8	22	1988	DRY	3	ND	0.1	ND	0.1	ND	0.1	ND	0.1	ND	0.2	ND	0
S3FD	8	22	1988	DRY	3	ND	0.1	ND	0.1	ND	0.1	ND	0.1	ND	0.2	ND	0

		Date Sampled					MALATHION		MERPHOS		MEVINPHOS		MONOCROTOPHOS		NALED	
Sample I.D.	Month	Day	Year	Sample Type	Sample Event	actual mg/kg	D.L. mg/kg	actual mg/kg	D.L. mg/kg	actual mg/kg	D.L. mg/kg	actual mg/kg	D.L. mg/kg	actual mg/kg	D.L. mg/kg
							0.01		0.01		0.01		0.01		0.01
STANDARD REPORTING OBJECTIVES															
S1	8	22	1988	DRY	3										
S2	8	22	1988	DRY	3	ND	0.25			ND	0.25	ND	1	ND	1.25
S3	8	22	1988	DRY	3	ND	0.1			ND	0.1	ND	0.4	ND	0.5
S3LR	8	22	1988	DRY	3	ND	0.1			ND	0.1	ND	0.4	ND	0.5
S4	8	22	1988	DRY	3	ND	0.1			ND	0.1	ND	0.4	ND	0.5
S3FD	8	22	1988	DRY	3	ND	0.1			ND	0.1	ND	0.4	ND	0.5

Sample I.D.	Date Sampled Month	Day	Year	Sample Type	Sample Event	PARATHION, ETH actual mg/kg	D.L. mg/kg	PARATHION, METH actual mg/kg	D.L. mg/kg	PHORATE actual mg/kg	D.L. mg/kg	RONNEL actual mg/kg	D.L. mg/kg	SULFOTEPP actual mg/kg	D.L. mg/kg
							0.01		0.01		0.01		0.01		0.01
STANDARD REPORTING OBJECTIVES															
S1	8	22	1988	DRY	3										
S2	8	22	1988	DRY	3	ND	0.25	ND	0.25	ND	0.25	ND	0.25	ND	0.25
S3	8	22	1988	DRY	3	ND	0.1	ND	0.1	ND	0.1	ND	0.1	ND	0.1
S3LR	8	22	1988	DRY	3	ND	0.1	ND	0.1	ND	0.1	ND	0.1	ND	0.1
S4	8	22	1988	DRY	3	ND	0.1	ND	0.1	ND	0.1	ND	0.1	ND	0.1
S3FD	8	22	1988	DRY	3	ND	0.1	ND	0.1	ND	0.1	ND	0.1	ND	0.1

	Date Sampled					SULPROFOS		TEPP		TETRACHLORVINPHOS		TRICHLORONATE	
Sample I.D.	Month	Day	Year	Sample Type	Sample Event	actual mg/kg	D.L. mg/kg	actual mg/kg	D.L. mg/kg	actual mg/kg	D.L. mg/kg	actual mg/kg	D.L. mg/kg
STANDARD REPORTING OBJECTIVES							0.01		0.1		0.01		0.01
S1	8	22	1988	DRY	3								
S2	8	22	1988	DRY	3	ND	0.25	ND	2	ND	0.5	ND	ND
S3	8	22	1988	DRY	3	ND	0.1	ND	0.8	ND	0.2	ND	0.1
S3LR	8	22	1988	DRY	3	ND	0.1	ND	0.8	ND	0.2	ND	0.1
S4	8	22	1988	DRY	3	ND	0.1	ND	0.8	ND	0.2	ND	0.1
S3FD	8	22	1988	DRY	3	ND	0.1	ND	0.8	ND	0.2	ND	0.1

D.6 Polynuclear Aromatic Hydrocarbons

POLYNUCLEAR AROMATIC HYDROCARBONS

Abbreviated Name	Actual Name
ACENAPE	Acenaphthene
ACENAPTYLE	Acenapthylene
BAA	Benzo(a)anthracene
BAP	Benzo(a)pyrene
BBF	Benzo(b)fluoranthene
BGHIP	Benzo(ghi)perylene
BKF	Benzo(k)fluoranthene
DBAHA	Dibenzo(a,h)anthracene
FLUORANTHN	Fluoranthene
ICDP	Indeno(1,2,3-cd)pyrene
PHENANTHRN	Phenanthrene

D.6-1 Polynuclear Aromatic Hydrocarbons in water column

	Date Sampled					ACENAPE		ACENAPTYLE		ANTHRACENE		BAA		BAP		BBF	
Sample I.D.	Month	Day	Year	Sample Type	Sample Event	actual ug/l	D.L. ug/l	actual ug/l	D.L. ug/l	actual ug/l	D.L. ug/l	actual ug/l	D.L. ug/l	actual ug/l	D.L. ug/l	actual ug/l	D.L. ug/l
STANDARD REPORTING OBJECTIVES							2		2		2		2		2		2
L1	2	4	1989	WET	4	ND	200	ND	200	ND	7.0	ND	8.0	ND	5.0	ND	2.0
L1	2	9	1989	WET	5	ND	10	ND	10	ND	3.5	0.56	0.40	0.91	0.25	0.78	0.10
L1LR	2	9	1989	WET	5	ND	10	ND	10	ND	3.5	0.60	0.40	1.0	0.25	0.86	0.10
L1	3	2	1989	WET	6	ND	20	ND	200	ND	7.0	ND	0.80	ND	0.50	0.49	0.20
L2	2	4	1989	WET	4	ND	20	ND	200	ND	7.0	ND	0.80	ND	0.50	ND	0.20
L2	2	9	1989	WET	5	ND	10	ND	10	ND	0.70	ND	0.40	ND	0.25	0.10	0.10
L3	2	4	1989	WET	4	ND	20	ND	200	ND	7.0	ND	0.80	ND	0.50	ND	0.20
L3	2	9	1989	WET	5	ND	10	ND	20	ND	3.5	ND	0.40	ND	0.25	ND	0.10
L3	3	2	1989	WET	6	ND	20	ND	20	ND	7.0	ND	0.80	ND	0.50	ND	0.20
L4	2	4	1989	WET	4	ND	20	ND	20	ND	0.70	ND	0.080	ND	0.50	ND	0.20
L4	2	9	1989	WET	5	ND	10	ND	10	ND	3.5	ND	0.40	ND	0.25	ND	0.10
L5	1	23	1989	WET	3	ND	20	ND	20	ND	0.70	ND	0.080	ND	0.50	ND	0.20
L5	2	4	1989	WET	4	ND	20	ND	20	ND	7.0	ND	0.80	ND	0.50	0.28	0.20
L5	2	9	1989	WET	5	ND	10	ND	20	ND	3.5	ND	0.40	ND	0.50	0.32	0.10
L5	3	2	1989	WET	6	ND	20	ND	20	ND	7.0	ND	0.80	ND	0.50	0.27	0.20
L5LR	2	4	1989	WET	4	ND	20	ND	20	ND	7.0	ND	0.80	ND	0.50	0.26	0.20
L5FD	2	4	1989	WET	4	ND	20	ND	20	ND	7.0	ND	0.80	ND	0.50	0.33	0.20
L6	2	9	1989	WET	5	ND	10	ND	20	ND	3.5	ND	0.40	ND	0.50	ND	0.20
L7	2	4	1989	WET	4	ND	2.0	ND	2.0	ND	0.70	ND	0.080	ND	0.050	ND	0.020
L7	2	9	1989	WET	5	ND	2.0	ND	2.0	ND	0.70	ND	0.080	ND	0.050	ND	0.020
L7	3	2	1989	WET	6	ND	2.0	ND	2.0	ND	0.70	ND	0.080	ND	0.050	ND	0.020
S1	3	30	1988	DRY	2	ND	5	ND	5	ND	5	ND	5	ND	5	ND	5
S1LR	3	30	1988	DRY	2	ND	5	ND	5	ND	5	ND	5	ND	5	ND	5
S1	5	11	1988	DRY	3	ND	2	ND	2	ND	2	ND	2	ND	2	ND	2
S1	12	12	1988	DRY	5	ND	2.0	ND	2.0	ND	0.70	ND	0.080	ND	0.050	ND	0.020
S1	2	1	1989	DRY	6	ND	2.0	ND	2.0	ND	0.70	ND	0.080	ND	0.050	ND	0.020
S1	4	6	1989	DRY	7	ND	2.0	ND	2.0	ND	0.70	ND	0.080	ND	0.050	ND	0.020
S1	1	23	1989	WET	3	ND	2.0	ND	2.0	ND	0.70	ND	0.080	ND	0.050	0.037	0.020
S1	2	4	1989	WET	4	ND	20	ND	20	ND	7.0	ND	0.80	0.52	0.50	0.46	0.20
S1	2	9	1989	WET	5	ND	10	ND	10	ND	3.5	ND	0.40	ND	0.25	0.16	0.10
S1FD	2	9	1989	WET	5	ND	10	ND	20	ND	3.5	ND	0.40	ND	0.25	ND	0.10
S1	3	2	1989	WET	6	ND	20	ND	20	ND	7.0	ND	0.80	ND	0.50	0.36	0.20
S1LR	3	2	1989	WET	6	ND	20	ND	20	ND	7.0	ND	0.80	ND	0.50	0.31	0.20

Sample I.D.	Date Sampled			Sample Type	Sample Event	ACENAPE		ACENAPTYLE		ANTHRACENE		BAA		BAP		BBF	
	Month	Day	Year			actual ug/l	D.L. ug/l	actual ug/l	D.L. ug/l	actual ug/l	D.L. ug/l	actual ug/l	D.L. ug/l	actual ug/l	D.L. ug/l	actual ug/l	D.L. ug/l
STANDARD REPORTING OBJECTIVES							2		2		2		2		2		2
S2	3	30	1988	DRY	2	ND	5	ND	5	ND	5	ND	5	ND	5	ND	5
S2	5	11	1988	DRY	3	ND	2	ND	2	ND	2	ND	2	ND	2	ND	2
S2	12	12	1988	DRY	5	ND	2.0	ND	2.0	ND	0.70	ND	0.080	ND	0.050	ND	0.020
S2	2	1	1989	DRY	6	ND	2.0	ND	2.0	ND	0.70	ND	0.080	ND	0.050	ND	0.020
S2	4	6	1989	DRY	7	ND	2.0	ND	2.0	ND	0.70	ND	0.080	ND	0.050	ND	0.020
S2	1	23	1989	WET	3	ND	20	ND	20	ND	0.70	ND	0.080	0.081	0.050	0.089	0.020
S2	2	4	1989	WET	4	ND	20	ND	20	ND	7.0	ND	0.80	ND	0.50	ND	0.20
S2	2	9	1989	WET	5	ND	20	ND	200	ND	3.5	ND	0.80	ND	0.50	0.67	0.20
S2	3	2	1989	WET	6	ND	20	ND	20	ND	7.0	ND	0.80	ND	0.50	ND	0.20
S3	3	30	1988	DRY	2	ND	5	ND	5	ND	5	ND	5	ND	5	ND	5
S3	5	11	1988	DRY	3	ND	2	ND	2	ND	2	ND	2	ND	2	ND	2
S3	8	22	1988	DRY	4	ND	1	ND	1	ND	1	ND	1	ND	1	ND	10
S3FD	8	22	1988	DRY	4	ND	1	ND	1	ND	1	ND	1	ND	1	ND	1
S3FDLR	8	22	1988	DRY	4	ND	1	ND	1	ND	1	ND	1	ND	1	ND	1
S3	12	12	1988	DRY	5	ND	2.0	ND	2.0	ND	0.70	ND	0.080	ND	0.050	ND	0.020
S3FD	12	12	1988	DRY	5	ND	2.0	ND	2.0	ND	0.70	ND	0.080	ND	0.050	ND	0.020
S3LR	12	12	1988	DRY	5	ND	2.0	ND	2.0	ND	0.70	ND	0.080	ND	0.050	ND	0.020
S3	2	1	1989	DRY	6	ND	2.0	ND	2.0	ND	0.70	ND	0.080	ND	0.050	ND	0.020
S3FD	2	1	1989	DRY	6	ND	2.0	ND	2.0	ND	0.70	ND	0.080	ND	0.050	ND	0.020
S3LR	2	1	1989	DRY	6	ND	2.0	ND	2.0	ND	0.70	ND	0.080	ND	0.050	ND	0.020
S3	4	6	1989	DRY	7	ND	2.0	ND	2.0	ND	0.70	ND	0.080	ND	0.050	ND	0.020
S3FD	4	6	1989	DRY	7	ND	2.0	ND	2.0	ND	0.70	ND	0.080	ND	0.050	ND	0.020
S3	1	23	1989	WET	3	ND	20	ND	20	ND	0.70	ND	0.080	ND	0.50	ND	0.20
S3FD	1	23	1989	WET	3	ND	20	ND	20	ND	0.70	ND	0.080	ND	0.50	ND	0.20
S3	2	4	1989	WET	4	ND	20	ND	20	ND	7.0	ND	0.80	ND	0.50	ND	0.20
S3	2	9	1989	WET	5	ND	10	ND	20	ND	3.5	ND	0.40	ND	0.25	ND	0.10
S4	3	30	1988	DRY	2	ND	5	ND	5	ND	5	ND	5	ND	5	ND	5
S4	5	11	1988	DRY	3	ND	2	ND	2	ND	2	ND	2	ND	2	ND	2
S4LR	5	11	1988	DRY	3	ND	2	ND	2	ND	2	ND	2	ND	2	ND	2
S4	8	22	1988	DRY	4	ND	1	ND	1	ND	1	ND	1	ND	50	ND	1
S4	12	12	1988	DRY	5	ND	2.0	ND	2.0	ND	0.70	ND	0.080	0.11	0.050	0.083	0.020
S4	2	1	1989	DRY	6	ND	2.0	ND	2.0	ND	0.70	ND	0.080	ND	0.050	ND	0.020
S4	4	6	1989	DRY	7	ND	2.0	ND	20	ND	0.70	ND	0.080	ND	0.050	ND	0.020
S4	2	4	1989	WET	4	ND	20	ND	20	ND	7.0	ND	0.80	ND	0.50	ND	0.20
S4	2	9	1989	WET	5	ND	10	ND	20	ND	3.5	ND	0.40	ND	0.25	ND	0.10
S4	3	2	1989	WET	6	ND	20	ND	20	ND	7.0	ND	0.80	ND	0.50	ND	0.20

Sample I.D.	Date Sampled			Sample Type	Sample Event	ACENAPE		ACENAPTYLE		ANTHRACENE		BAA		BAP		BBF	
	Month	Day	Year			actual ug/l	D.L. ug/l	actual ug/l	D.L. ug/l	actual ug/l	D.L. ug/l	actual ug/l	D.L. ug/l	actual ug/l	D.L. ug/l	actual ug/l	D.L. ug/l
STANDARD REPORTING OBJECTIVES							2		2		2		2		2		2
5B	1	23	1989	WET	3	ND	2.0	ND	2.0	ND	0.70	ND	0.080	ND	0.050	ND	0.020
5B	2	4	1989	WET	4	ND	2.0	ND	2.0	ND	0.70	ND	0.080	ND	0.050	ND	0.020
5B	2	9	1989	WET	5	ND	2.0	ND	2.0	ND	0.70	ND	0.080	ND	0.050	ND	0.020
5B	3	2	1989	WET	6	ND	2.0	ND	2.0	ND	0.70	ND	0.080	ND	0.050	ND	0.020
FB	8	22	1988	DRY	4	ND	1	ND	1	ND	1	ND	1	ND	1	ND	1
FB	12	12	1988	DRY	5	ND	2.0	ND	2.0	ND	0.70	ND	0.080	ND	0.050	ND	0.020
FB	2	1	1989	DRY	6	ND	2.0	ND	2.0	ND	0.70	ND	0.080	ND	0.050	ND	0.020
FB	4	6	1989	DRY	7	ND	2.0	ND	2.0	ND	0.70	ND	0.080	ND	0.050	ND	0.020

Sample I.D.	Date Sampled Month	Day	Year	Sample Type	Sample Event	BGHIP actual ug/l	BGHIP D.L. ug/l	BKF actual ug/l	BKF D.L. ug/l	CHRYSENE actual ug/l	CHRYSENE D.L. ug/l	DBAHA actual ug/l	DBAHA D.L. ug/l	FLUORANTHN actual ug/l	FLUORANTHN D.L. ug/l	FLUORENE actual ug/l	FLUORENE D.L. ug/l
STANDARD REPORTING OBJECTIVES							2		2		2		2		2		2
L1	2	4	1989	WET	4	ND	8.0	ND	2.0	ND	20	ND	20	3.3	2.0	ND	2.0
L1	2	9	1989	WET	5	1.3	0.40	0.34	0.10	ND	1.0	ND	1.0	2.4	1.0	ND	1.0
L1LR	2	9	1989	WET	5	1.5	0.40	0.37	0.10	ND	1.0	ND	1.0	2.6	1.0	ND	1.0
L1	3	2	1989	WET	6	ND	0.80	0.22	0.20	ND	20	ND	2.0	ND	2.0	ND	2.0
L2	2	4	1989	WET	4	ND	0.80	ND	0.20	ND	20	ND	2.0	ND	2.0	ND	2.0
L2	2	9	1989	WET	5	ND	0.40	ND	0.10	ND	1.0	ND	1.0	ND	0.20	ND	1.0
L3	2	4	1989	WET	4	ND	0.80	ND	0.20	ND	20	ND	2.0	ND	2.0	ND	2.0
L3	2	9	1989	WET	5	ND	0.40	ND	0.10	ND	2.0	ND	1.0	ND	1.0	ND	1.0
L3	3	2	1989	WET	6	ND	0.80	ND	0.20	ND	2.0	ND	2.0	ND	2.0	ND	2.0
L4	2	4	1989	WET	4	ND	0.080	ND	0.20	ND	2.0	ND	2.0	ND	0.20	ND	2.0
L4	2	9	1989	WET	5	ND	0.40	ND	0.10	ND	1.0	ND	1.0	ND	1.0	ND	1.0
L5	1	23	1989	WET	3	ND	0.80	ND	0.20	ND	2.0	ND	2.0	0.26	0.20	ND	2.0
L5	2	4	1989	WET	4	ND	0.80	ND	0.20	ND	20	ND	2.0	ND	2.0	ND	2.0
L5	2	9	1989	WET	5	ND	0.40	0.14	0.10	ND	2.0	ND	1.0	ND	1.0	ND	1.0
L5	3	2	1989	WET	6	ND	0.80	ND	0.20	ND	2.0	ND	2.0	ND	2.0	ND	2.0
L5LR	2	4	1989	WET	4	ND	0.80	ND	0.20	ND	2.0	ND	2.0	ND	2.0	ND	2.0
L5FD	2	4	1989	WET	4	ND	0.80	ND	0.20	ND	2.0	ND	2.0	ND	2.0	ND	2.0
L6	2	9	1989	WET	5	ND	0.40	ND	0.20	ND	2.0	ND	2.0	ND	1.0	ND	1.0
L7	2	4	1989	WET	4	ND	0.080	ND	0.020	ND	0.20	ND	0.20	ND	0.20	ND	0.20
L7	2	9	1989	WET	5	ND	0.080	ND	0.020	ND	0.20	ND	0.20	ND	0.20	ND	0.20
L7	3	2	1989	WET	6	ND	0.080	ND	0.020	ND	0.20	ND	0.20	ND	0.20	ND	0.20
S1	3	30	1988	DRY	2	ND	5	ND	5	ND	5	ND	5	ND	5	ND	5
S1LR	3	30	1988	DRY	2	ND	5	ND	5	ND	5	ND	5	ND	5	ND	5
S1	5	11	1988	DRY	3	ND	2	ND	2	ND	2	ND	2	ND	2	ND	2
S1	12	12	1988	DRY	5	ND	0.080	ND	0.020	ND	0.20	ND	0.20	ND	0.20	ND	0.20
S1	2	1	1989	DRY	6	ND	0.080	ND	0.020	ND	0.20	ND	0.20	ND	0.20	ND	0.20
S1	4	6	1989	DRY	7	ND	0.080	ND	0.020	ND	0.20	ND	0.20	ND	0.20	ND	0.50
S1	1	23	1989	WET	3	ND	0.080	ND	0.020	ND	0.20	ND	0.20	ND	0.20	ND	0.20
S1	2	4	1989	WET	4	ND	0.80	ND	0.20	ND	2.0	ND	2.0	ND	2.0	ND	2.0
S1	2	9	1989	WET	5	ND	0.40	ND	0.10	ND	1.0	ND	1.0	ND	1.0	ND	1.0
S1FD	2	9	1989	WET	5	ND	0.40	ND	0.10	ND	1.0	ND	1.0	ND	1.0	ND	1.0
S1	3	2	1989	WET	6	ND	0.80	ND	0.20	ND	2.0	ND	2.0	ND	2.0	ND	2.0
S1LR	3	2	1989	WET	6	ND	0.80	ND	0.20	ND	2.0	ND	2.0	ND	2.0	ND	2.0

	Date Sampled					BGHIP		BKF		CHRYSENE		DBAHA		FLUORANTHN		FLUORENE	
Sample I.D.	Month	Day	Year	Sample Type	Sample Event	actual ug/l	D.L. ug/l	actual ug/l	D.L. ug/l	actual ug/l	D.L. ug/l	actual ug/l	D.L. ug/l	actual ug/l	D.L. ug/l	actual ug/l	D.L. ug/l
STANDARD REPORTING OBJECTIVES							2		2		2		2		2		2
S2	3	30	1988	DRY	2	ND	5	ND	5	ND	5	ND	5	ND	5	ND	5
S2	5	11	1988	DRY	3	ND	2	ND	2	ND	2	ND	2	ND	2	ND	2
S2	12	12	1988	DRY	5	ND	0.080	ND	0.020	ND	0.20	ND	0.20	ND	0.20	ND	0.20
S2	2	1	1989	DRY	6	ND	0.080	ND	0.020	ND	0.20	ND	0.20	ND	0.20	ND	0.20
S2	4	6	1989	DRY	7	ND	0.080	ND	0.020	ND	0.20	ND	0.20	ND	0.20	ND	0.50
S2	1	23	1989	WET	3	ND	0.080	0.041	0.020	ND	2.0	ND	0.20	0.21	0.20	ND	2.0
S2	2	4	1989	WET	4	ND	0.80	ND	0.20	ND	2.0	ND	2.0	ND	2.0	ND	2.0
S2	2	9	1989	WET	5	ND	0.80	0.29	0.20	ND	20	ND	2.0	1.1	1.0	ND	2.0
S2	3	2	1989	WET	6	ND	0.80	ND	0.20	ND	2.0	ND	2.0	ND	2.0	ND	2.0
S3	3	30	1988	DRY	2	ND	5	ND	5	ND	5	ND	5	ND	5	ND	5
S3	5	11	1988	DRY	3	ND	2	ND	2	ND	2	ND	2	ND	2	ND	2
S3	8	22	1988	DRY	4	ND	2	ND	1	ND	1	ND	2	ND	1	ND	1
S3FD	8	22	1988	DRY	4	ND	2	ND	1	ND	1	ND	2	ND	1	ND	1
S3FDLR	8	22	1988	DRY	4	ND	2	ND	1	ND	1	ND	2	ND	1	ND	1
S3	12	12	1988	DRY	5	ND	0.080	ND	0.020	ND	0.20	ND	0.20	ND	0.20	ND	0.20
S3FD	12	12	1988	DRY	5	ND	0.080	ND	0.020	ND	0.20	ND	0.20	ND	0.20	ND	0.20
S3LR	12	12	1988	DRY	5	ND	0.080	ND	0.020	ND	0.20	ND	0.20	ND	0.20	ND	0.20
S3	2	1	1989	DRY	6	ND	0.080	ND	0.020	ND	0.20	ND	0.20	ND	0.20	ND	0.20
S3FD	2	1	1989	DRY	6	ND	0.080	ND	0.020	ND	0.20	ND	0.20	ND	0.20	ND	0.20
S3LR	2	1	1989	DRY	6	ND	0.080	ND	0.020	ND	0.20	ND	0.20	ND	0.20	ND	0.20
S3	4	6	1989	DRY	7	ND	0.080	ND	0.020	ND	0.20	ND	0.20	ND	0.20	ND	0.50
S3FD	4	6	1989	DRY	7	ND	0.080	ND	0.020	ND	0.20	ND	0.20	ND	0.20	ND	0.50
S3	1	23	1989	WET	3	ND	0.80	ND	0.20	ND	2.0	ND	2.0	0.29	0.20	ND	2.0
S3FD	1	23	1989	WET	3	ND	0.80	ND	0.20	ND	2.0	ND	2.0	0.26	0.20	ND	2.0
S3	2	4	1989	WET	4	ND	0.80	ND	0.20	ND	2.0	ND	2.0	ND	2.0	ND	2.0
S3	2	9	1989	WET	5	ND	0.40	ND	0.10	ND	1.0	ND	1.0	ND	1.0	ND	1.0
S4	3	30	1988	DRY	2	ND	5	ND	5	ND	5	ND	5	ND	5	ND	5
S4	5	11	1988	DRY	3	ND	2	ND	2	ND	2	ND	2	ND	2	ND	2
S4LR	5	11	1988	DRY	3	ND	2	ND	2	ND	2	ND	2	ND	2	ND	2
S4	8	22	1988	DRY	4	ND	50	ND	1	ND	1	ND	50	ND	1	ND	1
S4	12	12	1988	DRY	5	ND	0.080	0.04	0.020	ND	0.20	ND	0.20	ND	0.20	ND	0.20
S4	2	1	1989	DRY	6	ND	0.080	ND	0.020	ND	0.20	ND	0.20	ND	0.20	ND	0.20
S4	4	6	1989	DRY	7	ND	0.080	ND	0.020	ND	0.20	ND	0.20	ND	0.20	ND	0.50
S4	2	4	1989	WET	4	ND	0.80	ND	0.20	ND	2.0	ND	2.0	ND	2.0	ND	2.0
S4	2	9	1989	WET	5	ND	0.40	ND	0.10	ND	1.0	ND	1.0	ND	1.0	ND	1.0
S4	3	2	1989	WET	6	ND	0.80	ND	0.20	ND	2.0	ND	2.0	ND	2.0	ND	2.0

Sample I.D.	Date Sampled Month	Day	Year	Sample Type	Sample Event	BGHIP actual ug/l	BGHIP D.L. ug/l	BKF actual ug/l	BKF D.L. ug/l	CHRYSENE actual ug/l	CHRYSENE D.L. ug/l	DBAHA actual ug/l	DBAHA D.L. ug/l	FLUORANTHN actual ug/l	FLUORANTHN D.L. ug/l	FLUORENE actual ug/l	FLUORENE D.L. ug/l
STANDARD REPORTING OBJECTIVES							2		2		2		2		2		2
5B	1	23	1989	WET	3	ND	0.080	ND	0.020	ND	0.20	ND	0.20	ND	0.20	ND	0.20
5B	2	4	1989	WET	4	ND	0.080	ND	0.020	ND	0.20	ND	0.20	ND	0.20	ND	0.20
5B	2	9	1989	WET	5	ND	0.080	ND	0.020	ND	0.20	ND	0.20	ND	0.20	ND	0.20
5B	3	2	1989	WET	6	ND	0.080	ND	0.020	ND	0.20	ND	0.20	ND	0.20	ND	0.20
FB	8	22	1988	DRY	4	ND	2	ND	1	ND	1	ND	2	ND	1	ND	1
FB	12	12	1988	DRY	5	ND	0.080	ND	0.020	ND	0.20	ND	0.20	ND	0.20	ND	0.20
FB	2	1	1989	DRY	6	ND	0.080	ND	0.020	ND	0.20	ND	0.20	ND	0.20	ND	0.20
FB	4	6	1989	DRY	7	ND	0.080	ND	0.020	ND	0.20	ND	0.20	ND	0.20	ND	0.50

Sample I.D.	Date Sampled Month	Date Sampled Day	Date Sampled Year	Sample Type	Sample Event	ICDP actual ug/l	ICDP D.L. ug/l	NAPTHALENE actual ug/l	NAPTHALENE D.L. ug/l	PHENANTHRN actual ug/l	PHENANTHRN D.L. ug/l	PYRENE actual ug/l	PYRENE D.L. ug/l
STANDARD REPORTING OBJECTIVES							2		2		2		2
L1	2	4	1989	WET	4	ND	20	ND	200	ND	6.0	ND	3.0
L1	2	9	1989	WET	5	1.4	1.0	ND	10	ND	3.0	2.0	1.5
L1LR	2	9	1989	WET	5	1.2	1.0	ND	10	ND	3.0	2.2	1.5
L1	3	2	1989	WET	6	ND	2.0	ND	200	ND	6.0	ND	3.0
L2	2	4	1989	WET	4	ND	2.0	ND	200	ND	6.0	ND	3.0
L2	2	9	1989	WET	5	ND	1.0	ND	10	ND	3.0	ND	0.30
L3	2	4	1989	WET	4	ND	2.0	ND	200	ND	6.0	ND	3.0
L3	2	9	1989	WET	5	ND	1.0	ND	20	ND	3.0	ND	1.5
L3	3	2	1989	WET	6	ND	2.0	ND	200	ND	6.0	ND	3.0
L4	2	4	1989	WET	4	ND	0.20	ND	20	ND	6.0	ND	0.30
L4	2	9	1989	WET	5	ND	1.0	ND	10	ND	3.0	ND	1.5
L5	1	23	1989	WET	3	ND	2.0	ND	20	ND	6.0	ND	0.30
L5	2	4	1989	WET	4	ND	2.0	ND	200	ND	6.0	ND	3.0
L5	2	9	1989	WET	5	ND	1.0	ND	20	ND	3.0	ND	1.5
L5	3	2	1989	WET	6	ND	2.0	ND	200	ND	6.0	ND	3.0
L5LR	2	4	1989	WET	4	ND	2.0	ND	200	ND	6.0	ND	3.0
L5FD	2	4	1989	WET	4	ND	2.0	ND	20	ND	6.0	ND	3.0
L6	2	9	1989	WET	5	ND	1.0	ND	20	ND	3.0	ND	1.5
L7	2	4	1989	WET	4	ND	0.20	ND	2.0	ND	0.60	ND	0.30
L7	2	9	1989	WET	5	ND	0.20	ND	2.0	ND	0.60	ND	0.30
L7	3	2	1989	WET	6	ND	0.20	ND	20	ND	0.60	ND	0.30
S1	3	30	1988	DRY	2	ND	5	ND	5	ND	5	ND	5
S1LR	3	30	1988	DRY	2	ND	5	ND	5	ND	5	ND	5
S1	5	11	1988	DRY	3	ND	2	ND	2	ND	2	ND	2
S1	12	12	1988	DRY	5	ND	0.20	ND	2.0	ND	0.60	ND	0.30
S1	2	1	1989	DRY	6	ND	0.20	ND	2.0	ND	0.60	ND	0.30
S1	4	6	1989	DRY	7	ND	0.20	ND	20	ND	0.60	ND	0.30
S1	1	23	1989	WET	3	ND	0.20	ND	2.0	ND	0.60	ND	0.30
S1	2	4	1989	WET	4	ND	2.0	ND	20	ND	6.0	ND	3.0
S1	2	9	1989	WET	5	ND	1.0	ND	20	ND	3.0	ND	1.5
S1FD	2	9	1989	WET	5	ND	1.0	ND	20	ND	3.0	ND	1.5
S1	3	2	1989	WET	6	ND	2.0	ND	200	ND	6.0	ND	3.0
S1LR	3	2	1989	WET	6	ND	2.0	ND	200	ND	6.0	ND	3.0

Sample I.D.	Date Sampled Month	Day	Year	Sample Type	Sample Event	ICDP actual ug/l	ICDP D.L. ug/l	NAPTHALENE actual ug/l	NAPTHALENE D.L. ug/l	PHENANTHRN actual ug/l	PHENANTHRN D.L. ug/l	PYRENE actual ug/l	PYRENE D.L. ug/l
STANDARD REPORTING OBJECTIVES							2		2		2		2
S2	3	30	1988	DRY	2	ND	5	ND	5	ND	5	ND	5
S2	5	11	1988	DRY	3	ND	2	ND	2	ND	2	ND	2
S2	12	12	1988	DRY	5	ND	0.20	ND	2.0	ND	0.60	ND	0.30
S2	2	1	1989	DRY	6	ND	0.20	ND	2.0	ND	0.60	ND	0.30
S2	4	6	1989	DRY	7	ND	0.20	ND	2.0	ND	0.60	ND	0.30
S2	1	23	1989	WET	3	ND	0.20	ND	20	ND	6.0	ND	0.30
S2	2	4	1989	WET	4	ND	2.0	ND	20	ND	6.0	ND	3.0
S2	2	9	1989	WET	5	ND	2.0	ND	200	ND	6.0	ND	1.5
S2	3	2	1989	WET	6	ND	2.0	ND	200	ND	6.0	ND	3.0
S3	3	30	1988	DRY	2	ND	5	ND	5	ND	5	ND	5
S3	5	11	1988	DRY	3	ND	2	ND	2	ND	2	ND	2
S3	8	22	1988	DRY	4	ND	1	ND	1	ND	1	ND	1
S3FD	8	22	1988	DRY	4	ND	1	ND	1	ND	1	ND	1
S3FDLR	8	22	1988	DRY	4	ND	1	ND	1	ND	1	ND	1
S3	12	12	1988	DRY	5	ND	0.20	ND	20.0	ND	0.60	ND	0.30
S3FD	12	12	1988	DRY	5	ND	0.20	ND	2.0	ND	0.60	ND	0.30
S3LR	12	12	1988	DRY	5	ND	0.20	ND	2.0	ND	0.60	ND	0.30
S3	2	1	1989	DRY	6	ND	0.20	ND	2.0	ND	0.60	ND	0.30
S3FD	2	1	1989	DRY	6	ND	0.20	ND	2.0	ND	0.60	ND	0.30
S3LR	2	1	1989	DRY	6	ND	0.20	ND	2.0	ND	0.60	ND	0.30
S3	4	6	1989	DRY	7	ND	0.20	ND	20	ND	0.60	ND	0.30
S3FD	4	6	1989	DRY	7	ND	0.20	ND	20	ND	0.60	ND	0.30
S3	1	23	1989	WET	3	ND	2.0	ND	20	ND	6.0	0.33	0.30
S3FD	1	23	1989	WET	3	ND	2.0	ND	20	ND	6.0	0.32	0.30
S3	2	4	1989	WET	4	ND	2.0	ND	20	ND	6.0	ND	3.0
S3	2	9	1989	WET	5	ND	1.0	ND	20	ND	3.0	ND	1.5
S4	3	30	1988	DRY	2	ND	5	ND	5	ND	5	ND	5
S4	5	11	1988	DRY	3	ND	2	ND	2	ND	2	ND	2
S4LR	5	11	1988	DRY	3	ND	2	ND	2	ND	2	ND	2
S4	8	22	1988	DRY	4	ND	50	ND	1	ND	1	ND	1
S4	12	12	1988	DRY	5	ND	0.20	ND	2.0	ND	0.60	ND	0.30
S4	2	1	1989	DRY	6	ND	0.20	ND	2.0	ND	0.60	ND	0.30
S4	4	6	1989	DRY	7	ND	0.20	ND	20	ND	0.60	ND	0.30
S4	2	4	1989	WET	4	ND	2.0	ND	20	ND	6.0	ND	3.0
S4	2	9	1989	WET	5	ND	1.0	ND	20	ND	3.0	ND	1.5
S4	3	2	1989	WET	6	ND	2.0	ND	200	ND	6.0	ND	3.0

	Date Sampled					ICDP		NAPTHALENE		PHENANTHRN		PYRENE	
Sample I.D.	Month	Day	Year	Sample Type	Sample Event	actual ug/l	D.L. ug/l	actual ug/l	D.L. ug/l	actual ug/l	D.L. ug/l	actual ug/l	D.L. ug/l
STANDARD REPORTING OBJECTIVES							2		2		2		2
5B	1	23	1989	WET	3	ND	0.20	ND	2.0	ND	0.60	ND	0.30
5B	2	4	1989	WET	4	ND	0.20	ND	2.0	ND	0.60	ND	0.30
5B	2	9	1989	WET	5	ND	0.20	ND	2.0	ND	0.60	ND	0.30
5B	3	2	1989	WET	6	ND	0.20	ND	2.0	ND	0.60	ND	0.30
FB	8	22	1988	DRY	4	ND	1	ND	1	ND	1	ND	1
FB	12	12	1988	DRY	5	ND	0.20	ND	2.0	ND	0.60	ND	0.30
FB	2	1	1989	DRY	6	ND	0.20	ND	2.0	ND	0.60	ND	0.30
FB	4	6	1989	DRY	7	ND	0.20	ND	2.0	ND	0.60	ND	0.30

D.6-2 Polynuclear Aromatic Hydrocarbons in sediment

Sample I.D.	Date Sampled Month	Day	Year	Sample Type	Sample Event	ACENAPE actual mg/kg	ACENAPE D.L. mg/kg	ACENAPTYLE actual mg/kg	ACENAPTYLE D.L. mg/kg	ANTHRACENE actual mg/kg	ANTHRACENE D.L. mg/kg	BAA actual mg/kg	BAA D.L. mg/kg	BAP actual mg/kg	BAP D.L. mg/kg	BBF actual mg/kg	BBF D.L. mg/kg
STANDARD REPORTING LIMITS							0.2		0.2		0.2		0.2		0.2		0.2
S1	12	12	1988	DRY	5	ND	1.100	ND	1.100	ND	0.400	0.230	0.045	0.490	0.280	0.540	0.110
S2	12	12	1988	DRY	5	ND	0.660	ND	0.660	ND	0.230	0.100	0.026	0.200	0.160	0.190	0.066
S3	8	22	1988	DRY	4	ND	1	ND	1	ND	1	ND	1	ND	1	ND	10
S3	12	12	1988	DRY	5	ND	0.650	ND	0.650	ND	0.230	0.130	0.026	0.230	0.160	0.250	0.065
S3FD	8	22	1988	DRY	4	ND	1	ND	1	ND	1	ND	1	ND	1	ND	1
S3FD	12	12	1988	DRY	5	ND	0.910	ND	0.910	ND	0.320	ND	0.360	0.360	0.230	0.410	0.091
S4	8	22	1988	DRY	4	ND	1	ND	1	ND	1	ND	1	ND	50	ND	1
S4	12	12	1988	DRY	5	ND	0.710	ND	0.710	ND	0.250	0.270	0.180	0.270	0.180	0.360	0.071

	Date Sampled					BGHIP		BKF		CHRYSENE		DBAHA		FLUORANTHN	
Sample I.D.	Month	Day	Year	Sample Type	Sample Event	actual mg/kg	D.L. mg/kg	actual mg/kg	D.L. mg/kg	actual mg/kg	D.L. mg/kg	actual mg/kg	D.L. mg/kg	actual mg/kg	D.L. mg/kg
STANDARD REPORTING LIMITS							0.2		0.2		0.2		0.2		0.2
S1	12	12	1988	DRY	5	ND	0.450	0.270	0.110	ND	1.100	ND	0.110	0.910	0.110
S2	12	12	1988	DRY	5	ND	0.260	0.100	0.066	ND	0.660	ND	0.660	0.400	0.066
S3	8	22	1988	DRY	4	ND	2	ND	1	ND	1	ND	2	ND	1
S3	12	12	1988	DRY	5	ND	0.260	0.110	0.065	ND	0.650	ND	0.650	0.460	0.065
S3FD	8	22	1988	DRY	4	ND	2	ND	1	ND	1	ND	2	ND	1
S3FD	12	12	1988	DRY	5	ND	0.360	0.190	0.091	ND	0.910	ND	0.910	0.780	0.091
S4	8	22	1988	DRY	4	ND	50	ND	1	ND	1	ND	50	ND	1
S4	12	12	1988	DRY	5	ND	0.280	0.160	0.071	ND	0.710	ND	0.710	0.650	0.071

	Date Sampled					FLUORENE		ICDP		NAPTHALENE		PHENANTHRN		PYRENE	
Sample I.D.	Month	Day	Year	Sample Type	Sample Event	actual mg/kg	D.L. mg/kg	actual mg/kg	D.L. mg/kg	actual mg/kg	D.L. mg/kg	actual mg/kg	D.L. mg/kg	actual mg/kg	D.L. mg/kg
STANDARD REPORTING LIMITS							0.2		0.2		0.2		0.2		0.2
S1	12	12	1988	DRY	5	ND	0.110	ND	1.100	ND	1.100	0.350	0.340	0.650	0.170
S2	12	12	1988	DRY	5	ND	0.066	ND	0.660	ND	0.660	ND	0.200	0.350	0.098
S3	8	22	1988	DRY	4	ND	1	ND	1	ND	1	ND	1	ND	1
S3	12	12	1988	DRY	5	ND	0.065	ND	0.650	ND	0.650	ND	0.190	0.420	0.097
S3FD	8	22	1988	DRY	4	ND	1	ND	1	ND	1	ND	1	ND	1
S3FD	12	12	1988	DRY	5	ND	0.091	ND	0.910	ND	0.910	0.380	0.270	0.460	0.140
S4	8	22	1988	DRY	4	ND	1	ND	50	ND	1	ND	1	ND	1
S4	12	12	1988	DRY	5	ND	0.071	ND	0.710	ND	0.710	0.260	0.210	0.570	0.110

D.7 Volatiles and semi-volatiles

VOLATILES AND SEMI-VOLATILES

Abbreviated Name	Actual Name
3CLETHENE	Trichlorethene
METHYLECL	Methylene Chloride
B2ETHXPHTH	Bis(2-ethylhexyl) phthalate
2NOCTP	Di-n-octylphthalate

D.7-1 Volatiles and semi-volatiles in water column

Sample I.D.	Date Sampled Month	Day	Year	Sample Type	Sample Event	EPA 624 3CLETHE actual ug/l	D.L. ug/l	ACETONE actual ug/l	D.L. ug/l	2-BUTANONE actual ug/l	D.L. ug/l	METHYLE CL actual ug/l	D.L. ug/l	EPA 624 XYLENE-T actual ug/l	D.L. ug/l	TOLUENE actual ug/l	D.L. ug/l
STANDARD REPORTING OBJECTIVES																	
W. AVE	2	17	1988					80	20							13	5
L1	4	20	1988	WWWQ	1									9	5		
L1	11	23	1988	WWWQ	2							54	5				
L2	4	20	1988	WWWQ	1			45	20								
L2	11	23	1988	WWWQ	2			30	20	130	20			55	5		
L3	4	20	1988	WWWQ	1												
L3	11	23	1988	WWWQ	2												
L5	11	23	1988	WWWQ	2												
L6	4	20	1988	WWWQ	1												
L6	11	23	1988	WWWQ	2												
L7	11	23	1988	WWWQ	2												
R1	2	26	1988	RRWQ	1												
R2	2	26	1988	RRWQ	1												
R3	2	26	1988	RRWQ	1												
R4	2	26	1988	RRWQ	1												
R5	2	26	1988	RRWQ	1												
R6	2	26	1988	RRWQ	1												
S1	2	26	1988	DWWQ	1												
S1	11	23	1988	WWWQ	2												
S2	2	26	1988	DWWQ	1	6	5										
S2	4	20	1988	WWWQ	1												
S2	11	23	1988	WWWQ	2												
S3	2	26	1988	DWWQ	1												
S3	4	20	1988	WWWQ	1												
S3	11	23	1988	WWWQ	2												
S3LR	11	23	1988	WWWQ	2												
S4	2	26	1988	DWWQ	1												
S4	4	20	1988	WWWQ	1												
S4	11	23	1988	WWWQ	2												
S4LR	11	23	1988	WWWQ	2												

Sample I.D.	Date Sampled Month	Day	Year	Sample Type	Sample Event	EPA 625 B2ETHXPHTH actual ug/l	D.L. ug/l	2NOCTP actual ug/l	D.L. ug/l	BENZOIC AC actual ug/l	D.L. ug/l	4-METHPHN actual ug/l	D.L. ug/l
STANDARD REPORTING OBJECTIVES													
W. AVE	2	17	1988			320	10			430	50	29	10
L1	4	20	1988	WWWQ	1	41	10						
L1	11	23	1988	WWWQ	2								
L2	4	20	1988	WWWQ	1	49	10						
L2	11	23	1988	WWWQ	2								
L3	4	20	1988	WWWQ	1								
L3	11	23	1988	WWWQ	2								
L5	11	23	1988	WWWQ	2								
L6	4	20	1988	WWWQ	1	43	10						
L6	11	23	1988	WWWQ	2								
L7	11	23	1988	WWWQ	2								
R1	2	26	1988	RRWQ	1								
R2	2	26	1988	RRWQ	1								
R3	2	26	1988	RRWQ	1								
R4	2	26	1988	RRWQ	1								
R5	2	26	1988	RRWQ	1								
R6	2	26	1988	RRWQ	1								
S1	2	26	1988	DWWQ	1								
S1	11	23	1988	WWWQ	2								
S2	2	26	1988	DWWQ	1								
S2	4	20	1988	WWWQ	1								
S2	11	23	1988	WWWQ	2								
S3	2	26	1988	DWWQ	1								
S3	4	20	1988	WWWQ	1								
S3	11	23	1988	WWWQ	2								
S3LR	11	23	1988	WWWQ	2								
S4	2	26	1988	DWWQ	1	82	10	38	10				
S4	4	20	1988	WWWQ	1								
S4	11	23	1988	WWWQ	2								
S4LR	11	23	1988	WWWQ	2								

D.7-2 Volatiles and semi-volatiles in sediment

CHEMICAL	GROUP	STATION	SAMPLING DATE	CONCENTRATION (ug/kg)
Toluene	Volatile	S3	3/30/88	5
Acetone	Volatile	S3	3/30/88	63
BEHP	Semi-Volatile	S3	3/30/88	2700
		S3	5/11/88	970
		S4	5/11/88	4400
		S4.duplicate	5/11/88	1400
Butylbenzylphthalate	Semi-Volatile	S3	3/30/88	490
Fluoranthene	Semi-Volatile	S3	3/30/88	330
		S4	5/11/88	400
Pyrene	Semi-Volatile	S3	3/30/88	330

D.8 Dissolved Oxygen Data from Stream Stations and Settling Data

KINNETIC
LABORATORIES
INCORPORATED

P.O. BOX 1040
307 WASHINGTON STREET
SANTA CRUZ, CA 95061
(408) 426-3900

SANTA CLARA URBAN RUNOFF STUDY
10-11 February 89
Assessment of Discrete and Persistent Dissolved Oxygen

The following data are from samples collected at four stations in the Santa Clara Urban Runoff study area, at five-to-seven hour intervals.

STATION	LOCATION	DATE	TIME COLLECTED	x (mg/L) CONCENTRATION	STANDARD DEVIATION
S-1	Wilcox	10FEB89	04:40	11.83	0.042
S-1	Wilcox	10FEB89	10:30	11.66	0.071
S-1	Wilcox	10FEB89	17:30	10.81	0.127
S-1	Wilcox	10FEB89	23:00	10.03	0.028
S-1	Wilcox	11FEB89	04:00	8.94	0.106
S-1	Wilcox	11FEB89	09:00	10.31	0.014
S-1	Wilcox	11FEB89	15:00	10.01	0.071

Dane D. Hardin

Dane D. Hardin
Regional Manager

• ANCHORAGE, AK • SANTA CRUZ, CA • CARLSBAD, CA • KIHEI, HI •

KINNETIC
LABORATORIES
INCORPORATED

P.O. BOX 1040
307 WASHINGTON STREET
SANTA CRUZ, CA 95061
(408) 426-3900

SANTA CLARA URBAN RUNOFF STUDY
10-11 February 89
Assessment of Discrete and Persistent Dissolved Oxygen

The following data are from samples collected at four stations in the Santa Clara Urban Runoff study area, at five-to-seven hour intervals.

STATION	LOCATION	DATE	TIME COLLECTED	x (mg/L) CONCENTRATION	STANDARD DEVIATION
S-2	Bayshore	10FEB89	04:13	11.33	0.106
S-2	Bayshore	10FEB89	09:50	10.81	0.170
S-2	Bayshore	10FEB89	16:50	10.59	0.078
S-2	Bayshore	10FEB89	22:05	9.27	0.028
S-2	Bayshore	11FEB89	03:30	8.61	0.035
S-2	Bayshore	11FEB89	08:30	9.19	0.049
S-2	Bayshore	11FEB89	14:30	12.18	0.042

Dane D. Hardin

Dane D. Hardin
Regional Manager

SANTA CLARA URBAN RUNOFF STUDY
10-11 February 89
Assessment of Discrete and Persistent Dissolved Oxygen

The following data are from samples collected at four stations in the Santa Clara Urban Runoff study area, at five-to-seven hour intervals.

STATION	LOCATION	DATE	TIME COLLECTED	x (mg/L) CONCENTRATION	STANDARD DEVIATION
S-3	Guadalupe	10FEB89	05:40	10.26	0.028
S-3	Guadalupe	10FEB89	12:10	10.04	0.028
S-3	Guadalupe	10FEB89	15:17	9.81	0.064
S-3	Guadalupe	10FEB89	20:25	9.85	0.0
S-3	Guadalupe	11FEB89	01:30	9.83	0.049
S-3	Guadalupe	11FEB89	06:30	9.65	0.014
S-3	Guadalupe	11FEB89	12:45	10.42	0.735

Dane D. Hardin

Dane D. Hardin
Regional Manager

KINNETIC
LABORATORIES
INCORPORATED

P.O. BOX 1040
LABORATORY: 307 WASHINGTON STREET
SANTA CRUZ, CALIFORNIA 95061
(408) 426-3900

SANTA CLARA URBAN RUNOFF STUDY
10-11 February 89
Assessment of Discrete and Persistent Dissolved Oxygen

PAGE 4 OF 4

The following data are from samples collected at four stations in the Santa Clara Urban Runoff study area, at two-to-seven hour intervals.

STATION	LOCATION	DATE	TIME COLLECTED	x (mg/L) CONCENTRATION	STANDARD DEVIATION
S-4	Coyote	10FEB89	01:15	9.44	N/A*
S-4	Coyote	10FEB89	03:10	8.70	0.042
S-4	Coyote	10FEB89	08:57	9.03	0.049
S-4	Coyote	10FEB89	16:05	8.47	0.021
S-4	Coyote	10FEB89	21:30	8.89	0.071
S-4	Coyote	11FEB89	03:00	8.84	0.057
S-4	Coyote	11FEB89	08:00	8.83	0.049
S-4	Coyote	11FEB89	14:05	9.57	0.134

*Only one sample was collected at this site.

Dane D Hardin

Dane D. Hardin
Regional Manager

Distribution of Settling Valocities - Pooled Test Results

Vs ft/hr	% Greater Than S-1	S-2	S-3	S-4	Avg % Remov 4 tests	Avg % Remov for Vs	Vs ft/hr
0.021	84	64	45	86	70	70	0.021
0.042	91	68	45	59	66		
0.042	89	71	82	77	80	73	0.042
0.063	88	54	77	68	72	72	0.063
0.083	71	50	64	54	59		
0.083	85	68	77	67	74		
0.083	73	89	86	75	81	72	0.083
0.125	85	82	59	64	72	72	0.125
0.167	60	68	77	38	61		
0.167	65	32	59	54	52		
0.167	71	57	68	68	66	60	0.167
0.250	73	50	18	55	49	49	0.250
0.333	53	43	59	46	50		
0.333	69	39	59	55	56	53	0.333
0.500	38	57	14	16	31		
0.500	54	14	32	23	31	31	0.500
0.667	49	21	23	20	28	28	0.667
1.000	31	46	-9	13	20	20	1.000
1.500	26	-7	23	-6	9	9	1.500
2.000	11	-11	14	0	3	3	2.000

Santa Clara Settling Column Test Results

STA	SAMP PORT	MEASURED TSS CONCENTRATIONS					sett time <-hours->	PERCENT TSS REMOVED				
		2 hr	6 hr	12 hr	24 hr	48 hr	sett dist (feet)	2	6	12	24	48
S-1		85 mg/l = initial TSS										
	1	53	34	25	8	14	1	38	60	71	91	84
	2	59	40	30	13	9	2	31	53	65	85	89
	3	63	39	23	13	10	3	26	54	73	85	88
	4	76	43	26	25	23	4	11	49	69	71	73
S-2		28 mg/l = initial TSS										
	1	12	9	14	9	10	1	86	89	84	89	88
	2	15	16	19	9	8	2	82	81	78	89	91
	3	30	24	14	5	13	3	65	72	84	94	85
	4	31	22	17	12	3	4	64	74	80	86	96
S-3		22 mg/l = initial TSS										
	1	19	5	8	12	12	1	78	94	91	86	86
	2	24	9	9	5	4	2	72	89	89	94	95
	3	17	15	18	9	5	3	80	82	79	89	94
	4	19	17	[illegible]	[illegible]	3	4	78	80	89	92	96
S-4		69 mg/l = initial TSS										
	1	58	43	32	28	10	1	32	49	62	67	88
	2	60	37	32	23	16	2	29	56	62	73	81
	3	73	53	31	25	22	3	14	38	64	71	74
	4	69	55	31	22	17	4	19	35	64	74	80

Distribution of Settling velocities

Vs ft/hr	% Greater Than S-1	S-2	S-3	S-4
0.021	84	64	45	86
0.042	91	68	45	59
0.042	89	71	82	77
0.063	88	54	77	68
0.083	71	50	64	54
0.083	85	68	77	67
0.083	73	89	86	75
0.125	85	82	59	64
0.167	60	68	77	38
0.167	65	32	59	54
0.167	71	57	68	68
0.250	73	50	18	55
0.333	53	43	59	46
0.333	69	39	59	55
0.500	38	57	14	16
0.500	54	14	32	23
0.667	49	21	23	20
1.000	31	46	-9	13
1.500	26	-7	23	-6
2.000	11	-11	14	0

APPENDIX E
SANTA CLARA TOXICITY DATA

E.1
WET-WEATHER TOXICITY DATA

MARINE BIOASSAY LABORATORIES
1234 HIGHWAY ONE
WATSONVILLE, CA 95076
(408) 724-4522

3 SPECIES BIOASSAY RESULTS:
SANTA CLARA VALLEY NON-POINT SOURCE PROGRAM
WET WEATHER TEST #1
SAMPLES RECEIVED 13 FEBRUARY, 1989 AND THEREAFTER

DRAFT

Prepared for

KINNETIC LABORATORIES, INC.
Santa Cruz, California

Prepared by

MARINE BIOASSAY LABORATORIES DIVISION
TOXSCAN, INC.
Watsonville, California

APRIL, 1989

MBL

A DIVISION OF TOXSCAN, INC.

Introduction

As part of the Santa Clara Valley Non-Point Source Program, toxicity testing must be carried out on water samples collected during both dry weather (four times) and wet weather (three times). Dry weather tests require daily collection of water samples at the four stream stations (S1-S4). Wet weather tests are conducted using a single composite sample of runoff water for the daily renewals. This test is the first of three wet weather tests. Three toxicity tests are conducted, utilizing Ceriodaphnia dubia (invertebrate), Pimephales promelas (fish) and Selenastrum capricornutum (plant).

The Ceriodaphnia and Pimephales tests are seven days in duration, and are static-renewal protocols, requiring daily replacement of test solutions. Collections of runoff water are made by MBL personnel and stored at 4°C. Aliquots of this stored water are used for daily renewals.

The three bioassays were performed concurrently. Daphnids and fish were run on 15-21 February, 1989. Algae were tested in two batches, 14-18 February and 15-19 February, 1989. Methods, results and data are presented in the following pages.

The samples were collected and delivered to MBL by Kinnetic Laboratories Inc. personnel. The experimental design called testing only undiluted (100%) stream water. A lab water control (EPA moderately-hard) was run to provide quality assurance data. The lab water results were also used as the comparative data for statistical comparisons.

Most of the runoff samples proved to be acutely toxic to Ceriodaphnia, producing 100% mortality within 8 hours of test initiation. Those acutely toxic samples were S1, S2, S3, L2, L3, L4, L5 AND L6. After consultation with our client, we prepared 1:10 dilutions of each of those samples and started the Ceriodaphnia test again using 10% concentrations.

Fathead minnow and Selenastrum bioassays were done with undiluted runoff samples.

Methods

Ceriodaphnia

Test organisms were neonates derived from in-house cultures. Original broodstock was from EPA Duluth, received 11 May, 1988 and cultured in EPA moderately hard water prepared with Milli-Q water. Samples of stream test water were collected daily during the test, and lab control water was EPA moderately hard (Milli-Q).

The test was initiated with 4-8 hour old neonates derived from third broods of individually maintained broodstock. Testing was conducted with 10 individuals per treatment, each in individual plastic cups containing 15 ml of test solution. Test temperature was 25 ± 1°C and photoperiod was 16 hour light:8 hour dark. Test solutions were renewed daily, concurrent with transfers, water quality measurements and assessment of survival and reproduction. At each daily transfer, new media were inoculated with food (2 drops of *Ceriodaphnia* chow and 1 drop of *Selenastrum* culture, density approximately 2.5×10^6 cells/ml). Following the 7-day test period, survival data was statistically evaluated using the probit method to calculate the 96-hour LC50. Reproductive data was evaluated using ANOVA and Dunnett's Test after confirming data homogeneity by Bartlett's Test. Test conditions and organism data are summarized in Appendix Table A-1.

Fathead Minnow Larvae

Test organisms were larvae, less than 24 hours old, obtained from in-house culture. All larvae were from the same spawning substrate, but probably from multiple spawns. Original broodstock was purchased from Thomas Fish Farms, San Rafael, California, approximately March of 1988. Stream test water samples were collected fresh each day. Control water was EPA moderately hard (Milli-Q). Ten larvae were used in each test container and there were three replicate containers per concentration. Each larval container was fed three times daily with 750-1000 newly-hatched *Artemia* nauplii. Test temperature was 25 ± 1°C, and photoperiod was 16:8. Daily renewal of 80% of the test volume coincided with daily environmental monitoring and assessment of survival. After seven days of exposure, the test was terminated by addition of formalin to each container. Surviving larvae were dried and weighed, and weight data were statistically evaluated using Bartlett's Test followed by ANOVA and Dunnett's Test. Probit analysis of survival data was used to calculate the 96-hour LC_1. Test conditions and organism data are summarized in appendix Table A-2.

Selenastrum

Algal assays were conducted in sterile 250 ml Erlenmeyer flasks. Preparation of the nutrient medium followed guidelines set forth in EPA-600/9-78-018.

All algal counts were made manually with a hemacytometer and microscope. Treatment groups and controls were set up with a minimum of three replicates. Testing was conducted in an environmental chamber with continuous illumination of 400 ft/candles at 24 ± 2°C for 96 hours. All test flasks were innoculated with approximately 1 X 10^4 cells/ml from a 4 day old stock culture. Cultures were shaken twice daily by hand. Upon conclusion of testing, statistical analyses were made of final cell densities to determine EC50 concentrations using the Probit Method. Bartlett's test was used to confirm homogeneity of variance after which Dunnett's test was used.

Results and Conclusions

Ceriodaphnia

On 14 February, testing was initiated on all samples. Within 8 hours, all daphnids in samples S1, S2, S3, L2, L3, L4, L5 and L6 had died. Ten percent dilutions of those samples were prepared using laboratory water, and the entire test was re-started on 15 February. The reproduction and survival data summarized in Tables 1 and 2 are the results of testing 100% concentrations of samples L1 and L7, and 10% concentrations of the samples listed above. Data were statistically analyzed using the laboratory water controls as the comparative data.

Analysis of survival data by Fisher's Exact Test showed that samples S1, L1 and L3 produced statistically significant mortality when compared with laboratory water controls. Following protocol guidelines, reproduction data for those samples was excluded from subsequent statistical analysis.

Reproduction data were found to be non-homogeneous, with a Bartlett's B value of 19.86 (tabled Bartletts value at P = 0.01 for 7 df = 18.48). This non-homogeneity could not be corrected by data transformation (square root, log, arcsin), and subsequent analysis was done by Steel's Many-One Rank Test. The tabulated critical rank sum value for n= 10 and K=8 at P=0.05 is 73. Rank sums for samples S-2 (55) and L3 (55) were less than 73, indicating that reproduction in these samples was significantly lower than in the laboratory control water.

Environmental monitoring data are tabulated and presented in Table 3.

Fathead Minnow Larvae

Survival and growth (dry weight) data are summarized in Table 4, and data for individual replicate test containers are presented in Table 5.

Mortality in samples L1 and L2 was significantly higher than in control water, and these data were excluded from further statistical analysis.

Larval weight data were normally distributed (Shapiro-Wilkes) but were not homogeneous (Bartletts B = 22.42). Data transformation (square root, log, arcsin) did not correct the non-homogeneity. Protocol guidance suggests that Steel's Many-One Rank Test be used to analyze growth data, but Steel's cannot be used when there are less than 4 replicates. Telephone guidance from EPA Cincinnati directed us to transform the data to produce the Bartletts B value closest to the critical number, and use that transformed data set to perform Dunnett's test. Square root transformation produced a Bartlett's B value of 17.64, compared with a critical B at 0.05 with 5 df of 15.09. Dunnett's analysis was done on the square root transformed weight data. There was no significant decrease in mean larval weight in samples L-4 and L-7 when compared with the weight of laboratory water controls. There was significantly decreased larval weight in samples S1, S2 and L5.

Environmental monitoring data for fathead minnow larvae are summarized in Table 6.

Selenastrum

Growth and environmental monitoring data are summarized in Table 7.

Because of the large number of samples, the test was run in two batches. Run #1 included samples L3, L4, L5, L6 and L7. Run #2 included samples S1, S2, S3, L1 and L2. Each sample set had its own control.

For Run #1, cell number data were normally distributed (Shapiro-Wilkes) and homogeneous (Bartletts B = 3.653 vs tabled X^2 value at p=0.01 and 5 d.f. = 15.09). ANOVA and Dunnetts analyses were done on the untransformed data. There was no significant decrease in mean cell numbers in samples L3 and L4 when compared with growth in lab water controls. There were significantly decreased cell numbers in sample L5, L6 and L7.

For Run #2, cell number data were normally distributed (Shapiro-Wilkes), but were not homogeneous. Square root transformation corrected the homogeneity (Bartlett's B = 14.88 vs tabled critical value for p=0.01 and df=5 of 15.09). ANOVA and Dunnett's tests were done on the square root-transformed data. There was no significant decrease in mean cell numbers in samples S1, S2 and S3 when compared with growth in lab water controls. There were significantly decreased cell numbers in samples L1 and L2.

TABLE 1

SUMMARY OF REPRODUCTION AND SURVIVAL FOR CERIODAPHNIA
Santa Clara Valley NPS Sample #3334

	Total Young Produced/Replicate										% Survival
Sample	a	b	c	d	e	f	g	h	i	j	(n = 10)
Control	22	22	20	27	27	24	20	20	26	22	100
**S-1	0*	0*	0*	0*	0*	0*	0*	0*	0*	0*	0
**S-2	17	14	12	17	15	10	19	21	19	16	100
**S-3	32	15	24	18	29	32	33	30	32	22	100
L-1	0	0	0	0	0*	0	0	0	0	0*	80
**L-2	18	23	33	24	23	28	34	32	33	37	100
**L-3	5*	16*	4*	0*	5*	5*	4*	5*	8*	4*	0
**L-4	5	24	28	16	28	25	20	13	22	0*	90
**L-5	15	0*	22	24	25	19	14	29	18	20	90
**L-6	29	33	32	35	34	30	33	32	30	39	100
L-7	30	24	30	25	30	33	29	32	30	32	100

* Adult died
** Sample was tested at 10% dilution

For Reproductive Data (excludes S1, L1 and L3)

Bartlett's B (calculated) = 19.86***
Tabled X^2 value (p=0.05, dF=7) = 18.48

Steel's Rank Sum, Sample S2 = 55
Steel's Rank Sum, Sample L3 = 55
Steel's Rank Sum, All others = >73

*** Data were not homogeneous and could not be corrected by transformation. Data were analyzed by Steel's Many-One Rank Test.

TABLE 2 CERIODAPHNIA REPRODUCTION AND SURVIVAL

Santa Clara Valley NPS Sample #3334

Sample	Day #	Replicate a	b	c	d	e	f	g	h	i	j	Total Young	# Live Adults
Control	4	5	4	0	4	5	4	4	2	6	2	36	10
	5	5	0	4	3	0	0	0	8	0	8	28	10
	6	0	8	5	8	10	8	6	0	8	0	53	10
	7	12	10	11	12	12	12	10	10	12	12	113	10
S-1	4	X	X	X	X	X	X	X	X	X	X	X	0
	5	-	-	-	-	-	-	-	-	-	-	-	0
	6	-	-	-	-	-	-	-	-	-	-	-	0
	7	-	-	-	-	-	-	-	-	-	-	-	0
S-2	4	4	4	4	5	0	0	3	3	2	4	29	40
	5	0	0	0	0	5	0	4	5	7	10	31	10
	6	8	10	8	12	10	10	0	1	0	0	59	10
	7	5	0	0	0	0	0	12	12	10	2	41	10
S-3	4	4	3	4	5	5	4	6	4	4	4	43	10
	5	0	0	0	10	8	12	9	10	10	10	69	10
	6	12	10	12	1	0	0	0	0	0	8	43	10
	7	16	2	8	2	16	16	18	16	18	X	112	9
L-1	4	0	0	0	0	0	0	0	0	0	0	0	10
	5	0	0	0	0	X	0	0	0	0	X	0	8
	6	0	0	0	0	-	0	0	0	0	-	0	8
	7	0	0	0	0	-	0	0	0	0	-	0	8
L-2	4	4	5	4	5	5	4	5	6	5	6	49	10
	5	10	8	10	10	0	0	0	0	0	0	38	10
	6	14	0	0	0	12	10	12	8	10	13	79	10
	7	0	10	10	12	6	14	17	18	18	18	123	10

X = Adult Died

TABLE 2 -cont. *CERIODAPHNIA* REPRODUCTION AND SURVIVAL

Santa Clara Valley NPS Sample #3334

Sample	Day #	Replicate										Total Young	# Live Adults
		a	b	c	d	e	f	g	h	i	j		
	4	5	4	0	4	5	4	4	2	6	2	36	10
	5	5	0	4	3	0	0	0	8	0	8	28	10
Control	6	0	8	5	8	10	8	6	0	8	0	53	10
	7	12	10	11	12	12	12	10	10	12	12	113	10
	4	5	4	4	X	5	5	4	5	4	4	40	9
	5	0	0	0	-	0	0	0	0	0	0	0	9
L-3	6	0	12	0	-	0	0	0	0	4	0	16	9
	7	X	X	X	-	X	X	X	X	X	X	0	0
	4	0	0	6	5	6	5	4	2	0	X	28	9
	5	5	8	0	0	0	0	0	8	8	-	29	9
L-4	6	0	10	10	11	10	12	8	0	8	-	69	9
	7	0	2	12	0	12	8	8	3	0	-	45	9
	4	2	X	4	5	5	3	5	4	6	7	41	9
	5	2	-	6	6	8	0	0	0	0	9	29	9
L-5	6	5	-	0	3	0	5	8	9	6	0	36	9
	7	10	-	12	10	12	11	1	16	6	4	82	9
	4	4	4	5	5	6	2	5	6	6	6	49	10
	5	0	0	0	0	0	0	0	0	0	0	0	10
L-6	6	7	11	9	10	8	10	12	8	10	13	98	10
	7	18	18	18	20	20	18	16	18	14	20	180	10
	4	6	4	6	5	4	5	3	6	5	6	50	10
	5	9	6	0	0	0	8	0	0	9	12	44	10
L-7	6	0	0	8	8	10	3	10	11	0	0	50	10
	7	15	14	16	12	16	17	16	15	16	14	151	10

X = Male Died

TABLE 3

CERIODAPHNIA - ENVIRONMENTAL MONITORING
Santa Clara Valley NPS Sample #3334

Dissolved Oxygen (mg/1)

	Day 1		Day 2		Day 3		Day 4		Day 5		Day 6		Day 7	
Sample	i*	f*	i	f	i	f	i	f	i	f	i	f	i	f
Control	8.2	6.6	8.2	7.2	8.2	7.4	8.2	7.9	8.1	7.8	8.2	7.8	8.1	7.8
S-1	9.4	6.4	8.7	7.3	9.0	7.1	8.5	7.6	8.8	7.7	8.4	7.8	8.4	7.7
S-2	9.0	6.4	8.9	7.7	9.0	7.0	8.1	8.0	9.0	7.9	8.8	7.8	8.7	7.8
S-3	8.3	6.5	8.0	7.3	8.5	7.4	8.5	8.0	8.2	7.8	8.2	7.8	8.0	7.8
L-1	9.4	6.4	9.6	7.0	10.0	6.7	10.2	7.8	9.8	7.8	9.2	7.8	10.0	7.8
L-2	9.0	6.5	8.8	7.7	9.0	7.2	9.2	7.9	8.6	7.9	8.6	7.8	8.5	7.8
L-3	9.0	6.3	9.2	7.3	9.0	7.3	10.0	7.9	9.4	7.8	9.2	7.7	8.0	7.8
L-4	9.4	6.8	9.2	7.4	9.4	7.5	9.6	8.0	9.4	7.9	9.8	7.7	9.4	7.8
L-5	9.0	6.6	9.0	7.4	9.0	7.7	7.9	7.9	8.6	7.8	8.2	7.9	8.0	7.8
L-6	9.1	6.7	8.6	7.4	9.1	7.5	9.2	7.9	8.5	7.8	8.0	7.8	8.0	7.9
L-7	9.2	6.7	9.0	7.3	9.2	7.4	10.3	8.0	9.0	7.8	9.8	7.8	9.4	7.6

*i = initial
f = final (just before renewal)

pH Value (units)

Sample	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
Control	8.0	8.1	7.9	7.7	8.0	7.9	7.9
S-1	6.6	7.1	6.7	7.0	6.9	6.6	6.5
S-2	7.5	7.4	7.1	7.2	7.2	7.0	7.0
S-3	7.9	7.7	7.4	7.5	7.4	7.3	7.3
L-1	10.5	10.4	10.4	10.4	10.2	10.1	10.4
L-2	7.3	7.1	6.8	6.5	6.7	6.7	6.7
L-3	7.3	7.4	7.0	6.6	6.8	6.7	6.7
L-4	8.0	8.0	7.6	7.8	7.6	7.6	7.6
L-5	7.4	7.4	6.9	7.1	7.0	6.9	6.9
L-6	7.4	7.5	7.3	7.1	7.1	7.1	7.0
L-7	8.2	8.3	8.0	8.1	8.0	7.8	7.9

TABLE 3 - continued CERIODAPHNIA - ENVIRONMENTAL MONITORING
Santa Clara Valley NPS Sample #3334

Conductivity (umhos/cm)

Sample	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
Control	270	270	270	270	270	270	270
S-1	115	120	120	120	120	120	120
S-2	168	165	165	165	165	165	165
S-3	290	290	290	290	290	290	290
L-1	750	775	775	775	775	775	775
L-2	78	80	80	80	80	80	80
L-3	58	70	70	70	70	70	70
L-4	1100	1100	1100	1100	1100	1100	1100
L-5	175	180	180	180	180	180	180
L-6	60	75	75	75	75	75	75
L-7	600	600	600	600	600	600	600

Temperature (°C)

Sample	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
Control	25.0	25.5	25.5	24.0	25.0	25.0	25.0
S-1	25.0	25.5	25.5	23.9	25.5	25.0	25.0
S-2	25.0	25.5	25.5	25.0	25.5	25.0	25.0
S-3	25.0	25.5	25.5	25.0	25.5	25.0	25.0
L-1	25.0	25.5	25.5	23.9	25.5	25.0	25.0
L-2	25.0	25.5	25.5	25.0	25.5	25.0	25.0
L-3	25.0	25.5	25.5	25.0	25.5	25.0	25.0
L-4	25.0	25.5	25.5	24.0	25.5	25.0	25.0
L-5	25.0	25.5	25.5	24.1	25.5	25.0	25.0
L-6	25.0	25.5	25.5	25.3	25.5	25.0	25.0
L-7	25.0	25.5	25.5	24.4	25.5	25.0	25.0

Alkalinity/Hardness (as mg/l CaCO3)

Sample	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
Control	68/104	68/104	68/104	68/104	68/104	68/104	68/104
S-1	44/36	44/36	44/36	44/36	44/36	44/36	44/36
S-2	62/68	62/68	62/68	62/68	62/68	62/68	62/68
S-3	129/136	129/136	129/136	129/136	129/136	129/136	129/136
L-1	258/32	258/32	258/32	258/32	258/32	258/32	258/32
L-2	34/28	34/28	34/28	34/28	34/28	34/28	34/28
L-3	26/26	26/26	26/26	26/26	26/26	26/26	26/26
L-4	210/440	210/440	210/440	210/440	210/440	210/440	210/440
L-5	45/56	45/56	45/56	45/56	45/56	45/56	45/56
L-6	38/32	38/32	38/32	38/32	38/32	38/32	38/32
L-7	212/230	212/230	212/230	212/230	212/230	212/230	212/230

TABLE 4

FATHEAD MINNOW LARVAE
MEAN PERCENT SURVIVAL (n=30) AND MEAN LARVAL DRY WEIGHT

Santa Clara Valley NPS Sample #3334

Sample	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	(mg) Mean Larval Dry Weight
Control	100	100	100	97	97	93	93	0.5407
S-1	100	100	100	100	100	97	97	0.3570
S-2	100	100	100	100	100	100	100	0.4200
L-1	37	33	29	0	0	0	0	------
L-2	0	0	0	0	0	0	0	------
L-4	100	100	97	97	97	97	97	0.5411
L-5	100	100	100	100	100	100	100	0.4100
L-7	100	100	100	100	97	97	97	0.4700

For Larval Weight Data (excludes L1 and L2)

Bartlett's B (calculated) = 22.42

Tabled X^2 value (p=0.01, 5 df) = 15.09

Bartlett's B (square root transformed data) = 17.64

ANOVA F (calculated) = 6.13

ANOVA F (tabled) = 3.11

TABLE 5

FATHEAD MINNOW LARVAE
SURVIVAL AND LARVAL DRY WEIGHT DATA

Santa Clara Valley NPS Sample #3334

		Number of Survivors								Mean Larval Dry
Sample	Replicate	Day 0	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Weight (mg)
Control	1	10	10	10	10	9	9	9	9	0.5222
	2	10	10	10	10	10	10	9	9	0.5000
	3	10	10	10	10	10	10	10	10	0.6000
S-1	1	10	10	10	10	10	10	9	9	0.4111
	2	10	10	10	10	10	10	10	10	0.4200
	3	10	10	10	10	10	10	10	10	0.3300
S-2	1	10	10	10	10	10	10	10	10	0.4400
	2	10	10	10	10	10	10	10	10	0.3800
	3	10	10	10	10	10	10	10	10	0.4400
L-1	1	10	1	1	1	1	0	0	0	------
	2	10	4	2	2	1	0	0	0	------
	3	10	6	6	5	1	0	0	0	------
L-2	1	10	0	0	0	0	0	0	0	------
	2	10	0	0	0	0	0	0	0	------
	3	10	0	0	0	0	0	0	0	------
L-4	1	10	10	10	10	10	10	10	10	0.4700
	2	10	10	10	9	9	9	9	9	0.6333
	3	10	10	10	10	10	10	10	10	0.5200
L-5	1	10	10	10	10	10	10	10	10	0.4300
	2	10	10	10	10	10	10	10	10	0.4100
	3	10	10	10	10	10	10	10	10	0.3900
L-7	1	10	10	10	10	10	10	10	10	0.4700
	2	10	10	10	10	10	10	10	10	0.4700
	3	10	10	10	10	10	9	9	9	0.4700

TABLE 6

FATHEAD MINNOW LARVAE - ENVIRONMENTAL MONITORING
Santa Clara Valley NPS Sample #3334

Dissolved Oxygen (mg/l)

	Day 1		Day 2		Day 3		Day 4		Day 5		Day 6		Day 7	
Sample	i*	f*	i	f	i	f	i	f	i	f	i	f	i	f
Control	8.2	6.3	8.2	6.8	8.2	6.9	8.2	7.1	8.1	7.0	8.2	7.0	8.1	6.6
S-1	9.4	5.5	8.7	6.0	9.0	5.5	8.5	6.4	8.8	6.1	8.4	6.2	8.4	6.0
S-2	9.0	5.6	8.9	5.7	9.0	5.4	8.1	6.2	9.0	5.4	8.8	5.1	8.7	5.9
L-1	9.4	5.6	9.6	5.2	10.0	5.0	10.2	4.2	9.8	4.5	9.2	---	10.0	---
L-2	9.0	5.4	8.8	---	9.0	---	9.2	---	8.6	---	8.6	---	8.5	---
L-4	9.4	6.0	9.2	6.6	9.4	6.4	9.6	6.7	9.4	6.3	9.8	6.0	9.4	6.2
L-5	9.0	5.6	9.0	6.2	9.0	6.1	7.9	6.7	8.6	6.5	8.2	6.3	8.0	6.3
L-7	9.2	6.3	9.0	6.9	9.2	6.5	10.3	6.8	9.0	6.7	9.8	6.5	9.4	6.5

*i = initial
f = final (just before renewal)

pH Value (units)

Sample	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
Control	8.0	8.1	7.9	7.7	8.0	7.9	7.9
S-1	6.6	7.1	6.7	7.0	6.9	6.6	6.5
S-2	7.5	7.4	7.1	7.2	7.2	7.0	7.0
L-1	10.5	10.4	10.4	10.4	10.2	10.1	10.4
L-2	7.3	7.1	6.8	6.5	6.7	6.7	6.7
L-4	8.0	8.0	7.6	7.8	7.6	7.6	7.6
L-5	7.4	7.4	6.9	7.1	7.0	6.9	6.9
L-7	8.2	8.3	8.0	8.1	8.0	7.8	7.9

TABLE 6 - continued

FATHEAD MINNOW LARVAE - ENVIRONMENTAL MONITORING
Santa Clara Valley NPS Sample #3334

Conductivity (umhos/cm)

Sample	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
Control	270	270	270	270	270	270	270
S-1	115	120	120	120	120	120	120
S-2	168	165	165	165	165	165	165
L-1	750	775	775	775	775	775	775
L-2	78	80	80	80	80	80	80
L-4	1100	1100	1100	1100	1100	1100	1100
L-5	175	180	180	180	180	180	180
L-7	600	600	600	600	600	600	600

Temperature (°C)

Sample	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
Control	25.0	25.5	25.5	24.0	25.0	25.0	25.0
S-1	25.0	25.5	25.5	23.9	25.5	25.0	25.0
S-2	25.0	25.5	25.5	25.0	25.5	25.0	25.0
L-1	25.0	25.5	25.5	23.9	25.5	25.0	25.0
L-2	25.0	25.5	25.5	25.0	25.5	25.0	25.0
L-4	25.0	25.5	25.5	24.0	25.5	25.0	25.0
L-5	25.0	25.5	25.5	24.1	25.5	25.0	25.0
L-7	25.0	25.5	25.5	24.4	25.5	25.0	25.0

Alkalinity/Hardness (as mg/l CaCO3)

Sample	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
Control	68/104	68/104	68/104	68/104	68/104	68/104	68/104
S-1	44/36	44/36	44/36	44/36	44/36	44/36	44/36
S-2	62/68	62/68	62/68	62/68	62/68	62/68	62/68
L-1	258/32	258/32	258/32	258/32	258/32	258/32	258/32
L-2	34/28	34/28	34/28	34/28	34/28	34/28	34/28
L-4	210/440	210/440	210/440	210/440	210/440	210/440	210/440
L-5	45/56	45/56	45/56	45/56	45/56	45/56	45/56
L-7	212/230	212/230	212/230	212/230	212/230	212/230	212/230

TABLE 7

SELENASTRUM CAPRICORNUTUM
GROWTH AND ENVIRONMENTAL MONITORING DATA
Santa Clara Valley NPS Sample #3334 - Run #1

Sample	Replicate 1	Cells/ml X 10^6 after 96 hours Replicate 2	Replicate 3	Mean
Control	3.17	3.17	3.37	3.24
L-3	3.39	3.22	3.43	3.35
L-4	3.13	3.20	3.43	3.25
L-5	1.22	1.28	1.15	1.22
L-6	2.73	2.21	2.39	2.44
L-7	1.92	2.30	2.23	2.15

Bartlett's B (calculated) = 3.653
Tabled X^2 value (p=0.01, df=5) = 15.01

ANOVA F (calculated) = 76.98
ANOVA F (tabled) = 3.11

Temperature (°C)

Sample	Day 1	Day 2	Day 3	Day 4
Control	23.8	24.2	24.0	24.7
L-3	23.8	24.2	24.0	24.7
L-4	23.8	24.2	24.0	24.7
L-5	23.8	24.2	24.0	24.7
L-6	23.8	24.2	24.0	24.7
L-7	23.8	24.2	24.0	24.7

Initial pH Value and Conductivity

Sample	pH value	Conductivity (umhos/cm)
Control	8.0	270
L-3	7.3	58
L-4	8.0	1100
L-5	7.4	175
L-6	7.4	60
L-7	8.2	600

TABLE 8

SELENASTRUM CAPRICORNUTUM
GROWTH AND ENVIRONMENTAL MONITORING DATA
Santa Clara Valley NPS Sample #3334 - Run #2

Sample	Cells/ml X 10^6 after 96 hours Replicate 1	Replicate 2	Replicate 3	Mean
Control	3.66	3.76	3.63	3.68
S-1	2.09	2.94	3.37	3.80
S-2	2.38	3.02	3.10	2.83
S-3	4.03	3.60	3.79	3.81
L-1	0.033	0.043	0.038	0.038
L-2	0.0022	0	0.010	0.0061

Bartlett's B (calculated) = 31.22
Tabled X^2 value (p=0.01, df=5) = 15.01
Bartlett's B (square root transformed data) = 14.88

ANOVA F (calculated) = 121.4
ANOVA F (tabled) = 3.11

Temperature (°C)

Sample	Day 1	Day 2	Day 3	Day 4
Control	24.3	24.4	24.8	24.5
S-1	24.3	24.4	24.8	24.5
S-2	24.3	24.4	24.8	24.5
S-3	24.3	24.4	24.8	24.5
L-1	24.3	24.4	24.8	24.5
L-2	24.3	24.4	24.8	24.5

Initial pH Value and Conductivity

Sample	pH value	Conductivity (umhos/cm)
Control	8.0	270
S-1	7.1	120
S-2	7.4	165
S-3	7.7	290
L-1	10.4	775
L-2	7.1	80

APPENDIX A

Summary of Test Conditions

TABLE A-1

Ceriodaphnia Bioassay

Test Type: Static Daily Renewal
Test Endpoints: Survival, Reproduction
Test Duration: 7 days - 168 hours
Temperature: 25 ± 1°C
Photoperiod: 16 L: 8 D
Start: 14 February, 1989, 11:00 hours
Finish: 21 February, 1989, 11:00 hours

Test Containers: 1 oz plastic cups
Test Volume: 15 ml
Dilution Water: Not Applicable

Test Material: Santa Clara Valley NPS - Wet Weather #1
Test Concentrations: 100%, controls
Replicates: 10
Organisms per replicate: 1

Test Species: *Ceriodaphnia dubia*
Source: in-house culture
Age: 4-8 hours
Acclimation/Culture Water: EPA Moderately Hard (Milli-Q)
Diet: Selenastrum, *Ceriodaphnia* chow

TABLE A-2

Fathead Minnow Bioassay

Test Type:	Static Daily Renewal
Test Endpoints:	Survival, Growth
Test Duration:	7 days - 168 hours
Temperature:	25 ± 1°C
Photoperiod:	16 L: 8 D
Start:	14 February, 1989, 12:30 hours
Finish:	21 February, 1989, 12:30 hours
Test Containers:	1 liter glass jars
Test Volume:	500 ml
Dilution Water:	Not Applicable
Test Material:	Santa Clara Valley NPS - Wet Weather #1
Test Concentrations:	100%, control
# Replicates:	3
Organisms per replicate:	10
Test Species:	*Pimephales promelas* (Fathead minnow)
Source:	in-house culture
Age:	<24 hours
Culture Water:	Dechlorinated Tap
Diet:	*Artemia* nauplii

TABLE A-3

Selenastrum Bioassay

Test Type:	Static
Test Endpoints:	Growth, (cell number)
Test Duration:	4 days, 96 hours
Temperature:	24 ± 2°C
Photoperiod:	Continuous light
Light Intensity:	400 ± 40 FC
Start:	14 & 15 February, 1989, 14:00 hours
Finish:	18 & 19 February, 1989, 14:00 hours
Test Containers:	250 ml Erlenmeyer flasks
Test Volume:	100 ml
Dilution Water:	Not Applicable
Test Material:	Santa Clara Valley NPS - Wet Weather #1
Test Concentrations:	100%, Control
# Replicates:	3
Organisms per replicate:	10,000/ml innoculated
Test Species:	*Selenastrum capricornutum*
Source:	In-house culture
Age:	4 days
Culture Water:	EPA Moderately Hard

MARINE BIOASSAY LABORATORIES
1234 HIGHWAY ONE
WATSONVILLE, CA 95076
(408) 724-4522

3 SPECIES BIOASSAY RESULTS:

SANTA CLARA VALLEY NON-POINT SOURCE PROGRAM

WET WEATHER TEST #2

SAMPLES RECEIVED 11 MARCH, 1989 AND THEREAFTER

Prepared for

KINNETIC LABORATORIES, INC.
Santa Cruz, California

Prepared by

MARINE BIOASSAY LABORATORIES DIVISION
TOXSCAN, INC.
Watsonville, California

MAY, 1989

MBL

A DIVISION OF TOXSCAN, INC.

Introduction

As part of the Santa Clara Valley Non-Point Source Program, toxicity testing must be carried out on water samples collected during both dry weather (four times) and wet weather (three times). Dry weather tests require daily collection of water samples at the four stream stations (S1-S4). Wet weather tests are conducted using a single composite sample of runoff water for the daily renewals. This test is the second of three wet weather tests. Three toxicity tests are conducted, utilizing *Ceriodaphnia dubia* (invertebrate), *Pimephales promelas* (fish) and *Selenastrum capricornutum* (plant).

The *Ceriodaphnia* and *Pimephales* tests are seven days in duration, and are static-renewal protocols, requiring daily replacement of test solutions. Collections of runoff water are made by MBL personnel and stored at 4°C. Aliquots of this stored water are used for daily renewals.

The three bioassays were performed concurrently. Daphnids and fish were run on 14-21 March, 1989. Algae were tested in two batches, 11-15 March and 12-16 March, 1989. Methods, results and data are presented in the following pages.

The samples were collected and delivered to MBL by Kinnetic Laboratories Inc. personnel. The experimental design called for testing only undiluted (100%) stream water. A lab water control (EPA moderately-hard) was run to provide quality assurance data. The lab water results were also used as the comparative data for statistical comparisons.

Some of the runoff samples proved to be acutely toxic to *Ceriodaphnia*, producing 100% mortality within 8 hours of test initiation. Those acutely toxic samples were S1, S2, L5 and L6. We prepared dilutions of each of those samples and started the *Ceriodaphnia* test again using 25% or 50% concentrations.

Fathead minnow and *Selenastrum* bioassays were done with undiluted runoff samples.

Methods

Ceriodaphnia

Test organisms were neonates derived from in-house cultures. Original broodstock was from EPA Duluth, received 11 May, 1988 and cultured in EPA moderately hard water prepared with Milli-Q water. Samples of stream test water were collected daily during the test, and lab control water was EPA moderately hard (Milli-Q).

The test was initiated with 4-8 hour old neonates derived from third broods of individually maintained broodstock. Testing was conducted with 10 individuals per treatment, each in individual plastic cups containing 15 ml of test solution. Test temperature was 25 ± 1°C and photoperiod was 16 hour light:8 hour dark. Test solutions were renewed daily, concurrent with transfers, water quality measurements and assessment of survival and reproduction. At each daily transfer, new media were inoculated with food (2 drops of *Ceriodaphnia* chow and 1 drop of *Selenastrum* culture, density approximately 2.5×10^6 cells/ml). Following the 7-day test period, survival data was statistically evaluated using the probit method to calculate the 96-hour LC50. Reproductive data was evaluated using ANOVA and Dunnett's Test after confirming data homogeneity by Bartlett's Test. Test conditions and organism data are summarized in Appendix Table A-1.

Fathead Minnow Larvae

Test organisms were larvae, less than 24 hours old, obtained from in-house culture. All larvae were from the same spawning substrate, but probably from multiple spawns. Original broodstock was purchased from Thomas Fish Farms, San Rafael, California, approximately March of 1988. Stream test water samples were collected fresh each day. Control water was EPA moderately hard (Milli-Q). Ten larvae were used in each test container and there were three replicate containers per concentration. Each larval container was fed three times daily with 750-1000 newly-hatched *Artemia* nauplii. Test temperature was 25 ± 1°C, and photoperiod was 16:8. Daily renewal of 80% of the test volume coincided with daily environmental monitoring and assessment of survival. After seven days of exposure, the test was terminated by addition of formalin to each container. Surviving larvae were dried and weighed, and weight data were statistically evaluated using Bartlett's Test followed by ANOVA and Dunnett's Test. Probit analysis of survival data was used to calculate the 96-hour LC_1. Test conditions and organism data are summarized in appendix Table A-2.

Selenastrum

Algal assays were conducted in sterile 250 ml Erlenmeyer flasks. Preparation of the nutrient medium followed guidelines set forth in EPA-600/9-78-018.

All algal counts were made manually with a hemacytometer and microscope. Treatment groups and controls were set up with a minimum of three replicates. Testing was conducted in an environmental chamber with continuous illumination of 400 ft/candles at 24 ± 2°C for 96 hours. All test flasks were innoculated with approximately $\bar{1} \times 10^4$ cells/ml from a 4 day old stock culture. Cultures were shaken twice daily by hand. Upon conclusion of testing, statistical analyses were made of final cell densities to determine EC50 concentrations using the Probit Method. Bartlett's test was used to confirm homogeneity of variance after which Dunnett's test was used.

Results and Conclusions

Ceriodaphnia

On 13 March, rangefinder acute testing was initiated on all samples. Within 8 hours, all daphnids in samples S1, S2, L5 and L6 had died. Dilutions of those samples were prepared using laboratory water, and the entire test was re-started on 14 February. The reproduction and survival data summarized in Tables 1 and 2 are the results of testing 100% concentrations of samples L1, L3, L4 and L7, 50% concentrations of samples S1 and L5 and 25% concentrations of samples S2 and L6. Data were statistically analyzed using the laboratory water controls as the comparative data.

Analysis of survival data by Fisher's Exact Test showed that all samples except L7 produced statistically significant mortality when compared with laboratory water controls. Following protocol guidelines, reproduction data for those samples was excluded from subsequent statistical analysis.

Mean young production for Sample L7 was higher (25.8 per adult) than laboratory water controls (17.3 per adult). No statistical analysis was necessary to determine that Sample L7 did not inhibit reproduction when compared with controls.

Environmental monitoring data are tabulated and presented in Table 3.

Fathead Minnow Larvae

Survival and growth (dry weight) data are summarized in Table 4, and data for individual replicate test containers are presented in Table 5.

Mortality in sample L1 was significantly higher than in control water, and these data were excluded from further statistical analysis.

Larval weight data were normally distributed (Shapiro-Wilkes) and homogeneous (Bartletts B = 7.324). Dunnett's analysis was done on the untransformed weight data. There was no significant decrease in mean larval weight in samples S1, S2, L5, and L7 when compared with the weight of laboratory water controls.

Environmental monitoring data for fathead minnow larvae are summarized in Table 6.

Selenastrum

Growth and environmental monitoring data are summarized in Table 7.

Because of the large number of samples, the test was run in two batches. Run #1 included samples S1, S2, S3, S4 and L1. Run #2 included samples L3, L4, L5, L6 and L7. Each sample set had its own control.

For Run #1, cell number data were normally distributed (Shapiro-Wilkes) and homogeneous (Bartletts B = 8.606 vs tabled X^2 value at p=0.01 and 4 d.f. = 13.28). There were no visible cells in sample L1 after four days of incubation, so these data were excluded from further statistical analysis. There were significantly decreased cell numbers in sample S1, S2, S3 and S4 when compared with growth in lab water controls.

For Run #2, cell number data were normally distributed (Shapiro-Wilkes) and homogeneous. (Bartlett's B = 9.736 vs tabled critical value for p=0.01 and df=5 of 15.09). ANOVA and Dunnett's tests were done on the untransformed data. There was no significant decrease in mean cell numbers in samples L3, L6 and L7 when compared with growth in lab water controls. There were significantly decreased cell numbers in samples L4 and L5.

TABLE 1

SUMMARY OF REPRODUCTION AND SURVIVAL FOR CERIODAPHNIA
Santa Clara Valley NPS Sample #3658

	Total Young Produced/Replicate										% Survival
Sample	a	b	c	d	e	f	g	h	i	j	(n = 10)
Control	21	17	6	19	17	18	17	20	18	20	100
S-1(50%)	0*	0*	0*	0*	0*	0*	0*	0*	0*	0*	0
S-2(25%)	0*	0*	3*	0*	4*	5*	0*	3*	0*	0*	0
L-1	0*	0*	0*	0*	0*	0*	0*	0*	0*	0*	0
L-3	0*	0*	0*	0*	0*	0*	0*	0*	0*	0*	0
L-4	22*	6*	3*	10*	9*	10*	14*	23	8*	11*	10
L-5(50%)	0*	4*	0*	4*	0*	2*	4*	1*	3*	4*	0
L-6(25%)	4*	2*	2*	0*	0*	4*	5*	0*	2*	4*	0
L-7	25	26	21	18	31	27	25	27	29	29	100

* Organism died prior to test completion.

TABLE 2

CERIODAPHNIA REPRODUCTION AND SURVIVAL

Santa Clara Valley NPS Sample #3658

Sample	Day #	Replicate										Total Young	# Live Adults
		a	b	c	d	e	f	g	h	i	j		
Control	4	5	3	2	4	1	4	3	3	4	4	33	10
	5	0	0	1	0	0	0	0	0	0	0	1	10
	6	6	6	3	7	8	6	6	8	6	8	64	10
	7	10	8	0	8	8	8	8	9	8	8	75	10
S-1 (50%)	4	X	X	X	X	X	X	X	X	X	X	0	0
	5	-	-	-	-	-	-	-	-	-	-	0	0
	6	-	-	-	-	-	-	-	-	-	-	0	0
	7	-	-	-	-	-	-	-	-	-	-	0	0
S-2 (25%)	4	X	X	3	X	4	5	X	3	X	X	15	4
	5	-	-	-	-	-	-	-	-	-	-	0	0
	6	-	-	-	-	-	-	-	-	-	-	0	0
	7	-	-	-	-	-	-	-	-	-	-	0	0
L-1 (100%)	4	X	X	X	X	X	X	X	X	X	X	0	0
	5	-	-	-	-	-	-	-	-	-	-	0	0
	6	-	-	-	-	-	-	-	-	-	-	0	0
	7	-	-	-	-	-	-	-	-	-	-	0	0
L-3 (100%)	4	X	X	X	X	X	X	X	X	X	X	0	0
	5	-	-	-	-	-	-	-	-	-	-	0	0
	6	-	-	-	-	-	-	-	-	-	-	0	0
	7	-	-	-	-	-	-	-	-	-	-	0	0
L-4 (100%)	4	4	0	3	4	3	4	5	4	5	4	36	10
	5	0	2	0	0	0	0	2	7	0	2	13	10
	6	9	4	X	6X	6X	6X	7	X	3X	5X	46	3
	7	9X	0X	-	-	-	-	-	12	-	-	21	1

X= Organism died prior to test completion

TABLE 2 (cont.) CERIODAPHNIA REPRODUCTION AND SURVIVAL

Santa Clara Valley NPS Sample #3658

Sample	Day #					Replicate						Total	# Live
		a	b	c	d	e	f	g	h	i	j	Young	Adults
Control	4	5	3	2	4	1	4	3	3	4	4	33	10
	5	0	0	1	0	0	0	0	0	0	0	1	10
	6	6	6	3	7	8	6	6	8	6	8	64	10
	7	10	8	0	8	8	8	8	9	8	8	75	10
L-5 (50%)	4	X	4X	X	4X	X	2X	4X	1X	3X	4X	22	0
	5	-	-	-	-	-	-	-	-	-	-	0	0
	6	-	-	-	-	-	-	-	-	-	-	0	0
	7	-	-	-	-	-	-	-	-	-	-	0	0
L-6 (50%)	4	4X	2	2X	X	X	4X	5X	X	2X	4X	23	1
	5	-	X	-	-	-	-	-	-	-	-	0	0
	6	-	-	-	-	-	-	-	-	-	-	0	0
	7	-	-	-	-	-	-	-	-	-	-	0	0
L-7 (100%)	4	4	4	4	4	6	5	4	5	6	4	46	10
	5	0	0	0	0	0	0	7	0	0	9	16	10
	6	8	10	7	7	8	9	0	10	9	0	68	10
	7	13	12	10	7	17	13	14	12	14	16	128	10

X= Organism died prior to test completion.

TABLE 3

CERIODAPHNIA - ENVIRONMENTAL MONITORING
Santa Clara Valley NPS Sample #3658

Dissolved Oxygen (mg/1)

Sample	Day 1		Day 2		Day 3		Day 4		Day 5		Day 6		Day 7	
	i*	f*	i	f	i	f	i	f	i	f	i	f	i	f
Control	7.8	7.7	7.8	7.6	7.6	7.5	7.7	7.7	7.7	7.7	8.1	7.6	8.1	7.2
S-1(50%)	7.7	7.5	8.5	7.5	8.3	7.5	-	-	-	-	-	-	-	-
S-2(25%)	8.7	7.5	10.0	7.5	9.1	7.5	9.8	7.5	9.4	-	-	-	-	-
L-1	6.5	502	707	706	707	705	-	-	-	-	-	-	-	-
L-3	9.6	7.2	9.4	7.6	-	-	-	-	-	-	-	-	-	-
L-4	9.5	7.6	9.2	7.6	8.9	7.5	9.2	7.7	9.2	7.7	9.4	7.6	9.3	5.6
L-5(50%)	9.2	7.4	9.2	7.6	9.6	7.5	10.1	7.6	10.3	-	-	-	-	-
L-6(50%)	8.6	7.2	10.0	7.5	8.6	7.5	8.4	7.1	-	-	-	-	-	-
L-7	9.6	7.6	10.2	7.6	9.8	7.6	10.0	7.7	10.4	7.5	10.2	7.6	10.1	6.4

*i = initial
f = final (just before renewal)

pH Value (units)

Sample	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
Control	7.8	8.0	7.9	7.9	7.8	7.8	7.9
S-1(50%)	6.5	6.5	6.6	-	-	-	-
S-2(25%)	6.7	6.8	6.9	6.8	6.9	-	-
L-1	5.6	5.7	5.9	-	-	-	-
L-3	6.4	6.6	-	-	-	-	-
L-4	7.7	7.9	8.0	7.9	7.9	7.9	7.9
L-5(50%)	6.4	6.5	6.7	6.7	6.4	-	-
L-6(50%)	6.7	6.8	7.2	7.2	-	-	-
L-7	7.8	7.9	7.9	7.8	7.8	7.9	7.8

TABLE 3 - continued

CERIODAPHNIA - ENVIRONMENTAL MONITORING
Santa Clara Valley NPS Sample #3658

Conductivity (umhos/cm)

Sample	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
Control	275	275	275	275	275	275	275
S-1	140	140	140	140	140	140	140
S-2	140	140	140	140	140	140	140
L-1	2700	2700	2700	2700	2700	2700	2700
L-3	110	110	110	110	110	110	110
L-4	1100	1100	1100	1100	1100	1100	1100
L-5	90	90	90	90	90	90	90
L-6	100	100	100	100	100	100	100
L-7	600	600	600	600	600	600	600

Temperature (°C)

Sample	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
Control	25.0	25.0	25.5	25.5	25.2	23.2	25.0
S-1	25.0	25.0	25.5	-	-	-	-
S-2	25.0	25.0	25.5	25.0	-	-	-
L-1	25.0	25.0	25.5	-	-	-	-
L-3	25.0	25.0	-	-	-	-	-
L-4	25.0	25.0	25.5	25.0	25.5	25.2	25.0
L-5	25.0	25.0	25.5	25.0	26.0	-	-
L-6	25.0	25.0	25.5	25.0	25.5	-	-
L-7	25.0	25.0	25.5	25.0	25.5	25.2	25.0

TABLE 3 - continued

CERIODAPHNIA - ENVIRONMENTAL MONITORING
Santa Clara Valley NPS Sample #3658

Alkalinity/Hardness (as mg/l CaCO3)

Sample	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
Control	78/102	78/102	78/102	78/102	78/102	78/102	78/102
S-1	57/56	57/56	57/56	57/56	57/56	57/56	57/56
S-2	58/66	58/66	58/66	58/66	58/66	58/66	58/66
L-1	274/88	274/88	274/88	274/88	274/88	274/88	274/88
L-3	28/32	28/32	28/32	28/32	28/32	28/32	28/32
L-4	214/508	214/508	214/508	214/508	214/508	214/508	214/508
L-5	32/44	32/44	32/44	32/44	32/44	32/44	32/44
L-6	32/44	32/44	32/44	32/44	32/44	32/44	32/44
L-7	222/272	222/272	222/272	222/272	222/272	222/272	222/272

TABLE 4

FATHEAD MINNOW LARVAE
MEAN PERCENT SURVIVAL (n=30) AND MEAN LARVAL DRY WEIGHT

Santa Clara Valley NPS Sample #3658

Sample	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	(mg) Mean Larval Dry Weight
Control	100	100	100	100	100	100	100	0.2566
S-1	100	100	100	100	100	100	100	0.3666
S-2	100	100	100	100	100	100	97	0.2907
L-1	0	0	0	0	0	0	0	____
L-5	100	100	100	100	100	100	100	0.3533
L-7	100	100	100	93	90	90	90	0.4214

For Larval Weight Data

Bartlett's B = 7.324
Tabled X^2 value (p=0.05, 4 df) = 13.28

ANOVA F (calculated) = 8.648
ANOVA F (tabled) = 3.48

TABLE 5

FATHEAD MINNOW LARVAE
SURVIVAL AND LARVAL DRY WEIGHT DATA

Santa Clara Valley NPS Sample #3658

		Number of Survivors								Mean Larval Dry
Sample	Replicate	Day 0	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Weight (mg)
Control	1	10	10	10	10	10	10	10	10	0.210
	2	10	10	10	10	10	10	10	10	0.300
	3	10	10	10	10	10	10	10	10	0.260
S-1	1	10	10	10	10	10	10	10	10	0.370
	2	10	10	10	10	10	10	10	10	0.400
	3	10	10	10	10	10	10	10	9	0.330
S-2	1	10	10	10	10	9	9	9	9	0.310
	2	10	10	10	10	10	9	8	8	0.340
	3	10	10	10	10	8	8	8	8	0.222
L-1	1	10	0	0	0	0	0	0	0	---
	2	10	0	0	0	0	0	0	0	---
	3	10	0	0	0	0	0	0	0	---
L-5	1	10	10	10	10	10	10	10	10	0.350
	2	10	10	10	10	10	10	10	10	0.360
	3	10	10	10	10	10	10	10	10	0.350
L-7	1	10	10	10	10	10	10	10	10	0.440
	2	10	10	10	10	10	10	10	10	0.410
	3	10	10	10	10	8	7	7	7	0.4142

TABLE 6

FATHEAD MINNOW LARVAE - ENVIRONMENTAL MONITORING
Santa Clara Valley NPS Sample #3658

Dissolved Oxygen (mg/l)

Sample	Day 1		Day 2		Day 3		Day 4		Day 5		Day 6		Day 7	
	i*	f*	i	f	i	f	i	f	i	f	i	f	i	f
Control	7.8	7.1	7.8	6.9	7.6	6.5	7.7	6.7	7.7	7.0	8.1	6.8	8.1	6.6
S-1	7.7	6.1	8.5	5.5	8.3	5.8	-	6.1	-	6.5	-	6.0	-	5.6
S-2	8.7	6.4	10.0	5.9	9.1	5.9	9.8	6.4	9.4	6.5	-	6.1	-	5.5
L-1	6.5	7.0	7.7	-	7.7	-	-	-	-	-	-	-	-	-
L-5	9.2	6.4	9.2	5.6	9.6	5.7	10.1	6.3	10.3	7.0	-	6.5	-	6.1
L-7	9.6	6.4	10.2	6.1	9.8	6.1	10.0	6.6	10.4	7.0	10.2	6.5	10.1	6.1

*i = initial
f = final (just before renewal)

pH Value (units)

Sample	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
Control	7.8	8.0	7.9	7.9	7.8	7.8	7.9
S-1	6.5	6.5	6.6	-	-	-	-
S-2	6.7	6.8	6.9	6.8	6.9	-	-
L-1	5.6	5.7	5.9	-	-	-	-
L-5	6.4	6.5	6.7	6.7	6.4	-	-
L-7	7.8	7.9	7.9	7.8	7.8	7.9	7.8

TABLE 6 - continued

FATHEAD MINNOW LARVAE - ENVIRONMENTAL MONITORING
Santa Clara Valley NPS Sample #3658

Conductivity (umhos/cm)

Sample	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
Control	275	275	275	275	275	275	275
S-1	140	140	140	140	140	140	140
S-2	140	140	140	140	140	140	140
L-1	2700	2700	2700	2700	2700	2700	2700
L-5	90	90	90	90	90	90	90
L-7	600	600	600	600	600	600	600

Temperature (°C)

Sample	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
Control	25.0	25.0	25.5	25.5	25.2	23.2	25.0
S-1	25.0	25.0	25.5	-	-	-	-
S-2	25.0	25.0	25.5	25.0	-	-	-
L-1	25.0	25.0	25.5	-	-	-	-
L-5	25.0	25.0	25.5	25.0	26.0	-	-
L-7	25.0	25.0	25.5	25.0	25.5	25.2	25.0

TABLE 6 - continued

CERIODAPHNIA - ENVIRONMENTAL MONITORING
Santa Clara Valley NPS Sample #3658

Alkalinity/Hardness (as mg/l CaCO3)

Sample	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
Control	78/102	78/102	78/102	78/102	78/102	78/102	78/102
S-1	57/56	57/56	57/56	57/56	57/56	57/56	57/56
S-2	58/66	58/66	58/66	58/66	58/66	58/66	58/66
L-1	274/88	274/88	274/88	274/88	274/88	274/88	274/88
L-5	32/44	32/44	32/44	32/44	32/44	32/44	32/44
L-7	222/272	222/272	222/272	222/272	222/272	222/272	222/272

TABLE 7

SELENASTRUM CAPRICORNUTUM
GROWTH AND ENVIRONMENTAL MONITORING DATA
Santa Clara Valley NPS Sample #3658

Sample	Replicate 1	Cells/ml X 10^6 after 96 hours Replicate 2	Replicate 3	Mean
Control	2.54	2.56	2.49	2.53
S-1	2.03	1.91	1.99	1.98
S-2	1.86	1.69	1.78	1.78
S-3	1.71	1.93	2.29	1.98
S-4	1.79	1.82	1.96	1.86
L-1	0	0	0	0

Bartlett's B (calculated) = 8.606
Tabled X^2 value (p=0.05, df=4) = 13.28

ANOVA F (calculated) = 12.34
ANOVA F (tabled) = 3.48

Temperature (°C)

Sample	Day 1	Day 2	Day 3	Day 4
Control	25.0	26.5	25.9	25.3
S-1	25.0	26.5	25.9	25.3
S-2	25.0	26.5	25.9	25.3
S-3	25.0	26.5	25.9	25.3
S-4	25.0	26.5	25.9	25.3
L-1	25.0	26.5	25.9	25.3

Initial pH Value and Conductivity

Sample	pH value	Conductivity (umhos/cm)
Control	7.6	275
S-1	7.2	140
S-2	7.4	140
S-3	7.9	-
S-4	8.0	-
L-1	6.1	2700

TABLE 8

SELENASTRUM CAPRICORNUTUM
GROWTH AND ENVIRONMENTAL MONITORING DATA
Santa Clara Valley NPS Sample #3658

	Cells/ml X 10^6 after 96 hours			
Sample	Replicate 1	Replicate 2	Replicate 3	Mean
Control	1.51	2.10	2.13	1.91
L-3	2.06	2.28	2.09	2.14
L-4	0.44	0.48	0.53	0.48
L-5	1.12	1.02	0.98	1.04
L-6	2.72	2.82	2.92	2.82
L-7	2.04	2.19	2.13	2.12

Bartlett's B (calculated) = 9.736
Tabled X^2 value (p=0.05, df=4) = 15.09

ANOVA F (calculated) = 80.66
ANOVA F (tabled) = 3.11

Temperature (°C)

Sample	Day 1	Day 2	Day 3	Day 4
Control	24.2	24.0	23.8	24.4
L-3	24.2	24.0	23.8	24.4
L-4	24.2	24.0	23.8	24.4
L-5	24.2	24.0	23.8	24.4
L-6	24.2	24.0	23.8	24.4
L-7	24.2	24.0	23.8	24.4

Initial pH Value and Conductivity

Sample	pH value	Conductivity (umhos/cm)
Control	7.5	275
L-3	6.9	110
L-4	8.0	1100
L-5	6.9	90
L-6	7.0	100
L-7	8.2	600

APPENDIX A

Summary of Test Conditions

TABLE A-1

Ceriodaphnia Bioassay

Test Type:	Static Daily Renewal
Test Endpoints:	Survival, Reproduction
Test Duration:	7 days - 168 hours
Temperature:	25 ± 1°C
Photoperiod:	16 L: 8 D
Start:	14 March, 1989, 13:00 hours
Finish:	21 March, 1989, 13:00 hours
Test Containers:	1 oz plastic cups
Test Volume:	15 ml
Dilution Water:	Not Applicable
Test Material:	Santa Clara Valley NPS - Wet Weather #2
Test Concentrations:	100%, 50%, 25%, controls
# Replicates:	10
Organisms per replicate:	1
Test Species:	*Ceriodaphnia dubia*
Source:	in-house culture
Age:	4-8 hours
Acclimation/Culture Water:	EPA Moderately Hard (Milli-Q)
Diet:	Selenastrum, *Ceriodaphnia* chow

TABLE A-2

Fathead Minnow Bioassay

Test Type:	Static Daily Renewal
Test Endpoints:	Survival, Growth
Test Duration:	7 days - 168 hours
Temperature:	25 ± 1°C
Photoperiod:	16 L: 8 D
Start:	14 March, 1989, 10:00 hours
Finish:	21 March, 1989, 10:00 hours
Test Containers:	1 liter glass jars
Test Volume:	500 ml
Dilution Water:	Not Applicable
Test Material:	Santa Clara Valley NPS - Wet Weather #2
Test Concentrations:	100%, control
# Replicates:	3
Organisms per replicate:	10
Test Species:	*Pimephales promelas* (Fathead minnow)
Source:	in-house culture
Age:	<24 hours
Culture Water:	Dechlorinated Tap
Diet:	*Artemia* nauplii

TABLE A-3

Selenastrum Bioassay

Test Type:	Static
Test Endpoints:	Growth, (cell number)
Test Duration:	4 days, 96 hours
Temperature:	24 ± 2°C
Photoperiod:	Continuous light
Light Intensity:	400 ± 40 FC
Start:	11 & 12 March, 1989, 14:00 hours
Finish:	15 & 16 March, 1989, 14:00 hours
Test Containers:	250 ml Erlenmeyer flasks
Test Volume:	100 ml
Dilution Water:	Not Applicable
Test Material:	Santa Clara Valley NPS - Wet Weather #2
Test Concentrations:	100%, Control
# Replicates:	3
Organisms per replicate:	10,000/ml innoculated
Test Species:	*Selenastrum capricornutum*
Source:	In-house culture
Age:	4 days
Culture Water:	EPA Moderately Hard

MARINE BIOASSAY LABORATORIES
1234 HIGHWAY ONE
WATSONVILLE, CA 95076
(408) 724-4522

3 SPECIES BIOASSAY RESULTS:

SANTA CLARA VALLEY NON-POINT SOURCE PROGRAM

WET WEATHER TEST #3

SAMPLES RECEIVED 28 MARCH, 1989 AND THEREAFTER

Prepared for

KINNETIC LABORATORIES, INC.
Santa Cruz, California

Prepared by

MARINE BIOASSAY LABORATORIES DIVISION
TOXSCAN, INC.
Watsonville, California

MAY, 1989

Introduction

As part of the Santa Clara Valley Non-Point Source Program, toxicity testing must be carried out on water samples collected during both dry weather (four times) and wet weather (three times). Dry weather tests require daily collection of water samples at the four stream stations (S1-S4). Wet weather tests are conducted using a single composite sample of runoff water for the daily renewals. This test is the third of three wet weather tests. Three toxicity tests are conducted, utilizing *Ceriodaphnia dubia* (invertebrate), *Pimephales promelas* (fish) and *Selenastrum capricornutum* (plant).

The *Ceriodaphnia* and *Pimephales* tests are seven days in duration, and are static-renewal protocols, requiring daily replacement of test solutions. Collections of runoff water are made by MBL personnel and stored at 4°C. Aliquots of this stored water are used for daily renewals.

The three bioassays were performed concurrently. Daphnids and fish were run on 28 March - 4 April, 1989. Algae were tested in two batches, both run on 30 March - 4 April, 1989. Methods, results and data are presented in the following pages.

The samples were collected and delivered to MBL by Kinnetic Laboratories Inc. personnel. The experimental design called for testing only undiluted (100%) stream water. A lab water control (EPA moderately-hard) was run to provide quality assurance data. The lab water results were also used as the comparative data for statistical comparisons.

Based upon previous wet weather test results, we expected many of the runoff samples to produce rapid and complete mortality in *Ceriodaphnia* tests. After one day of exposure in this test, however, most *Ceriodaphnia* were still alive, so we did not prepare dilutions of any of the test samples. All species were tested with undiluted runoff samples.

Methods

Ceriodaphnia

Test organisms were neonates derived from in-house cultures. Original broodstock was from EPA Duluth, received 11 May, 1988 and cultured in EPA moderately hard water prepared with Milli-Q water. Samples of stream test water were collected daily during the test, and lab control water was EPA moderately hard (Milli-Q).

The test was initiated with 4-8 hour old neonates derived from third broods of individually maintained broodstock. Testing was conducted with 10 individuals per treatment, each in individual plastic cups containing 15 ml of test solution. Test temperature was 25 ± 1°C and photoperiod was 16 hour light:8 hour dark. Test solutions were renewed daily, concurrent with transfers, water quality measurements and assessment of survival and reproduction. At each daily transfer, new media were inoculated with food (2 drops of *Ceriodaphnia* chow and 1 drop of *Selenastrum* culture, density approximately 2.5×10^6 cells/ml). Following the 7-day test period, survival data was statistically evaluated using the probit method to calculate the 96-hour LC50. Reproductive data was evaluated using ANOVA and Dunnett's Test after confirming data homogeneity by Bartlett's Test. Test conditions and organism data are summarized in Appendix Table A-1.

Fathead Minnow Larvae

Test organisms were larvae, less than 24 hours old, obtained from in-house culture. All larvae were from the same spawning substrate, but probably from multiple spawns. Original broodstock was purchased from Thomas Fish Farms, San Rafael, California, approximately March of 1988. Stream test water samples were collected fresh each day. Control water was EPA moderately hard (Milli-Q). Ten larvae were used in each test container and there were three replicate containers per concentration. Each larval container was fed three times daily with 750-1000 newly-hatched *Artemia* nauplii. Test temperature was 25 ± 1°C, and photoperiod was 16:8. Daily renewal of 80% of the test volume coincided with daily environmental monitoring and assessment of survival. After seven days of exposure, the test was terminated by addition of formalin to each container. Surviving larvae were dried and weighed, and weight data were statistically evaluated using Bartlett's Test followed by ANOVA and Dunnett's Test. Probit analysis of survival data was used to calculate the 96-hour LC_1. Test conditions and organism data are summarized in appendix Table A-2.

Selenastrum

Algal assays were conducted in sterile 250 ml Erlenmeyer flasks. Preparation of the nutrient medium followed guidelines set forth in EPA-600/9-78-018.

All algal counts were made manually with a hemacytometer and microscope. Treatment groups and controls were set up with a minimum of three replicates. Testing was conducted in an environmental chamber with continuous illumination of 400 ft/candles at 24 ± 2°C for 96 hours. All test flasks were innoculated with approximately 1 X 10^4 cells/ml from a 4 day old stock culture. Cultures were shaken twice daily by hand. Upon conclusion of testing, statistical analyses were made of final cell densities to determine EC50 concentrations using the Probit Method. Bartlett's test was used to confirm homogeneity of variance after which Dunnett's test was used.

Results and Conclusions

Ceriodaphnia

Testing was initiated on 28 March, 1989. Reproduction and survival data are summarized in Table 1 and are presented in full in Table 2. Data was statistically analysed using the laboratory water as the comparitive dictum ("control").

Analysis of survival data by Fisher's Exact Test showed that all samples except L-2 and L-7 produced statistically significant mortality when compared with laboratory water controls. Following protocol guidelines, reproduction data for those samples was excluded from subsequent statistical analysis.

Reproduction data for control, L-2 and L-7 samples were found to be normally distributed (Shapiro-Wilkes test) and homogeneous (Bartlett's B = 2.760). Subsequent ANOVA and Dunnett's tests showed that there was significantly decreased young production in sample L-2 when compared with lab water controls. Sample L-7 was not significantly diferent from controls.

Environmental monitoring data are tabulated and presented in Table 3.

Fathead Minnow Larvae

Survival and growth (dry weight) data are summarized in Table 4, and data for individual replicate test containers are presented in Table 5.

Larval weight data were normally distributed (Shapiro-Wilkes) and homogeneous (Bartletts B = 11.89). Dunnett's analysis was done on the untransformed weight data. Mean larval weight in all samples tested was significantly decreased in comparison with larval weight of laboratory controls. For this data set, the minimum significant difference was 0.145 grams, representing a 17.9% reduction in larval weight from the control.

Environmental monitoring data for fathead minnow larvae are summarized in Table 6.

Selenastrum

Growth and environmental monitoring data are summarized in Table 7.

Because of the large number of samples, the test was run in two batches. Run #1 included samples L4, L5, L6 and L7. Run #2 included samples S1,S2,S4,L2,and L3. Each sample set had its own control.

For Run #1, cell number data were normally distributed (Shapiro-Wilkes) and homogeneous (Bartletts B = 8.941 vs tabled X^2 value at p=0.01 and 4 d.f. = 13.28). There were significantly decreased cell numbers in samples L4, L5, L6 and L7 when compared with growth in lab water controls.

For Run #2, cell number data were normally distributed (Shapiro-Wilkes) but were not homgeneous (Bartletts B = 16.84). Data transformation (square root, log, arcsin) did not correct the non-homogenity. Protocol guidance suggests that Steel's Many-One Rank Test be used to analyze growth data, but Steel's cannot be used when there are less than 4 replicates. Telephone guidance from EPA Cincinnati directed us to transform the data to produce the Bartletts B value closest to the critical number, and use that transformed data set to perform Dunnett's test. Square root transformation produced a Bartlett's B value of 15.58, compared with a critical B at 0.05 with a 5df of 15.09. Dunnett's analysis was done on the square root trasformed data. There was no significant decrease in cell number in samples S1, S2, and L3 when compared with laboratory water controls. There were significantly decreased cell numbers in samples S4 and L2.

TABLE 1

SUMMARY OF REPRODUCTION AND SURVIVAL FOR CERIODAPHNIA
Santa Clara Valley NPS Sample #3774

	Total Young Produced/Replicate										% Survival
	a	b	c	d	e	f	g	h	i	j (n = 10)	
Control	16	14	16	18	19	0*	19	20	18	16	90
S-1	0*	0*	0*	0*	0*	0*	0*	0*	0*	0*	0
S-2	0*	0*	0*	0*	0*	0*	0*	0*	0*	0*	0
S-4	2*	0*	0*	0*	4*	0*	0*	0*	1*	0*	0
L-2	17	2	0*	5	14	6	6	11	9	10	90
L-3	0*	0*	0*	0*	0*	0*	0*	0*	0*	0*	0
L-4	0*	0*	0*	0*	0*	0*	2*	2*	0*	0*	0
L-5	0*	0*	0*	0*	0*	0*	0*	0*	0*	0*	0
L-6	0*	0*	0*	0*	0*	0*	0*	0*	0*	0*	0
L-7	20	10	17	21	18	20	19	19	20	15	100

* Organism died prior to test completion.

For Reproductive Data

Bartlett's B = 2.760
Tabled X^2 value (p=0.01, 2 df) = 9.210

ANOVA F (calculated) = 11.23
ANOVA F (tabled) = 3.35

TABLE 2 CERIODAPHNIA REPRODUCTION AND SURVIVAL

Santa Clara Valley NPS Sample #3774

Sample	Day #	Replicate a	 b	 c	 d	 e	 f	 g	 h	 i	 j	Total Young	# Live Adults
	4	4	0	0	0	0	0	0	4	2	2	12	10
Control	5	0	3	0	2	7	X	6	0	0	0	18	9
	6	5	4	7	6	5	-	6	6	6	6	51	9
	7	7	7	9	10	7	-	7	10	10	8	75	9
	4	1	0	X	0	0	2	2	3	0	1	9	9
L-2	5	0	2	-	0	2	0	0	0	2	0	6	9
	6	10	0	-	1	4	0	0	5	1	4	26	9
	7	6	0	-	4	8	4	4	3	5	5	39	9
	4	3	2	3	2	3	2	2	1	2	2	22	10
L-7	5	0	0	0	0	0	0	2	0	8	6	16	10
	6	8	5	5	9	7	9	5	8	0	5	61	10
	7	9	3	9	10	8	9	10	10	10	2	80	10

X= Organism died prior to test completion

TABLE 3

CERIODAPHNIA - ENVIRONMENTAL MONITORING
Santa Clara Valley NPS Sample #3774

Dissolved Oxygen (mg/l)

	Day 1		Day 2		Day 3		Day 4		Day 5		Day 6		Day 7	
Sample	i*	f*	i	f	i	f	i	f	i	f	i	f	i	f
Control	7.6	7.6	7.4	7.7	7.5	7.9	7.5	7.6	7.6	7.5	7.7	7.6	7.6	7.1
S-1	9.1	7.5	8.6	7.6	-	-	-	-	-	-	-	-	-	-
S-2	8.9	7.4	8.2	7.6	7.9	7.6	-	-	-	-	-	-	-	-
S-4	8.6	7.5	7.5	7.6	8.0	7.7	9.1	7.6	-	-	-	-	-	-
L-2	8.7	7.4	8.0	7.4	7.9	7.7	8.7	7.6	8.1	7.5	7.4	7.7	8.0	7.0
L-3	8.4	7.4	8.0	7.4	8.3	7.6	9.0	7.6	-	-	-	-	-	-
L-4	8.7	7.5	8.6	7.5	8.7	7.8	9.7	7.5	-	-	-	-	-	-
L-5	9.7	7.4	18.8	7.5	8.9	7.7	9.5	7.6	-	-	-	-	-	-
L-6	7.4	7.4	-	-	-	-	-	-	-	-	-	-	-	-
L-7	9.8	7.4	9.3	7.4	9.6	7.9	9.4	7.6	9.4	7.5	9.8	7.7	9.8	6.7

*i= initial
f= final (just before renewal)

TABLE 3 - continued

CERIODAPHNIA - ENVIRONMENTAL MONITORING
Santa Clara Valley NPS Sample #3774

pH Value (units)

Sample	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
Control	7.9	8.0	8.2	8.0	7.9	8.0	8.0
S-1	7.1	7.0	-	-	-	-	-
S-2	7.3	7.3	7.3	-	-	-	-
S-4	5.6	7.9	7.9	7.7	-	-	-
L-2	7.0	6.9	6.8	6.8	6.6	6.7	6.6
L-3	6.7	6.8	6.5	6.4	-	-	-
L-4	8.0	8.0	8.1	8.0	-	-	-
L-5	6.8	6.7	6.8	6.7	-	-	-
L-6	6.7	-	-	-	-	-	-
L-7	7.8	7.8	8.0	7.8	7.8	7.6	7.6

Conductivity (umhos/cm)

Sample	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
Control	330	-	-	-	-	-	-
S-1	145	-	-	-	-	-	-
S-2	140	140	145	-	-	-	-
S-4	825	-	-	-	-	-	-
L-2	80	80	80	82	80	80	80
L-3	55	55	58	58	-	-	-
L-4	1500	1500	1400	1400	-	-	-
L-5	90	90	80	80	-	-	-
L-6	70	-	-	-	-	-	-
L-7	360	360	350	360	340	360	360

TABLE 3 - continued

CERIODAPHNIA - ENVIRONMENTAL MONITORING
Santa Clara Valley NPS Sample #3774

Temperature (°C)

Sample	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
Control	25.5	26	26	26	26	26	26
S-1	26	26	-	-	-	-	-
S-2	26	26	26	-	-	-	-
S-4	26	26	26.5	25.5	-	-	-
L-2	26	26	26	24.8	25.5	25	25.5
L-3	26	26	26.5	25	-	-	-
L-4	26	26	26	25	-	-	-
L-5	26	26	26.5	25	-	-	-
L-6	26	-	-	-	-	-	-
L-7	26	26	26.5	24	25.5	25	25.5

Alkalinity/Hardness (as mg/l CaCO3)

Sample	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
Control	87/120	87/120	87/120	87/120	87/120	87/120	87/120
S-1	48/46	48/46	48/46	48/46	48/46	48/46	48/46
S-2	52/60	52/60	52/60	50/60	52/60	52/60	52/60
S-4	200/165	200/165	200/165	200/165	200/165	200/165	200/165
L-2	35/40	35/40	35/40	35/40	35/40	35/40	35/40
L-3	35/24	35/24	35/24	35/24	35/24	35/24	35/24
L-4	295/583	295/583	295/583	295/583	295/583	295/583	295/583
L-5	42/32	42/32	42/32	42/32	42/32	42/32	42/32
L-6	47/28	47/28	47/28	47/28	47/28	47/28	47/28
L-7	155/176	155/176	155/176	155/176	155/176	155/176	155/176

APPENDIX A

Summary of Test Conditions

TABLE A-1

Ceriodaphnia Bioassay

Test Type:	Static Daily Renewal
Test Endpoints:	Survival, Reproduction
Test Duration:	7 days - 168 hours
Temperature:	25 ± 1°C
Photoperiod:	16 L: 8 D
Start:	12 December, 1988, 14:30 hours
Finish:	19 December, 1988, 14:30 hours
Test Containers:	1 oz plastic cups
Test Volume:	15 ml
Dilution Water:	Not Applicable
Test Material:	Santa Clara Valley NPS - Dry Weather #1
Test Concentrations:	100%, controls
# Replicates:	10
Organisms per replicate:	1
Test Species:	*Ceriodaphnia dubia*
Source:	in-house culture
Age:	4-8 hours
Acclimation/Culture Water:	EPA Moderately Hard (Milli-Q)
Diet:	Selenastrum, *Ceriodaphnia* chow

TABLE A-2

Fathead Minnow Bioassay

Test Type:	Static Daily Renewal
Test Endpoints:	Survival, Growth
Test Duration:	7 days - 168 hours
Temperature:	25 ± 1°C
Photoperiod:	16 L: 8 D
Start:	12 December, 1988, 11:00 hours
Finish:	19 December, 1988, 11:00 hours
Test Containers:	1 liter glass jars
Test Volume:	500 ml
Dilution Water:	Not Applicable
Test Material:	Santa Clara Valley NPS - Dry Weather #1
Test Concentrations:	100%, control
# Replicates:	3
Organisms per replicate:	10
Test Species:	*Pimephales promelas* (Fathead minnow)
Source:	in-house culture
Age:	<24 hours
Culture Water:	Dechlorinated Tap
Diet:	*Artemia* nauplii

TABLE A-3

Selenastrum Bioassay

Test Type:	Static
Test Endpoints:	Growth, (cell number)
Test Duration:	4 days, 96 hours
Temperature:	24 ± 2°C
Photoperiod:	Continuous light
Light Intensity:	400 ± 40 FC
Start:	13 December, 1988, 16:00 hours
Finish:	17 December, 1988, 16:00 hours
Test Containers:	250 ml Erlenmeyer flasks
Test Volume:	100 ml
Dilution Water:	Not Applicable
Test Material:	Santa Clara Valley NPS - Dry Weather #1
Test Concentrations:	100%, Control
# Replicates:	3
Organisms per replicate:	10,000/ml innoculated
Test Species:	*Selenastrum capricornutum*
Source:	In-house culture
Age:	4 days
Culture Water:	EPA Moderately Hard

TABLE 4

FATHEAD MINNOW LARVAE
MEAN PERCENT SURVIVAL (n=30) AND MEAN LARVAL DRY WEIGHT
Santa Clara Valley NPS Sample #3774

Sample	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	(mg) Mean Larval Dry Weight
Control	100	100	100	100	100	100	100	0.4065
S-1	100	100	100	100	100	97	97	0.2630
S-2	100	100	100	100	100	100	97	0.2730
L-2	100	100	93	93	90	90	90	0.1750
L-3	100	97	97	97	97	97	97	0.2550
L-5	100	100	100	100	97	97	97	0.2650
L-6	100	100	97	97	93	93	93	0.2580
L-7	100	100	100	100	100	100	100	0.3317

For Larval Weight Data

Bartlett's B = 11.89
Tabled X^2 value (p=0.05, 7 df) = 18.48

ANOVA F (calculated) = 11.05
ANOVA F (tabled) = 2.66

TABLE 5

FATHEAD MINNOW LARVAE
SURVIVAL AND LARVAL DRY WEIGHT DATA
Santa Clara Valley NPS Sample #3774

		Number of Survivors								Mean Larval Dry
Sample	Replicate	Day 0	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Weight (mg)
Control	1	10	10	10	10	10	10	10	10	0.400
	2	10	10	10	10	10	10	10	10	0.465
	3	10	10	10	10	10	10	10	10	0.355
S-1	1	10	10	10	10	10	10	10	10	0.235
	2	10	10	10	10	10	10	9	9	0.265
	3	10	10	10	10	10	10	10	10	0.290
S-2	1	10	10	10	10	10	10	10	10	0.275
	2	10	10	10	10	10	10	10	10	0.235
	3	10	10	10	10	10	10	10	10	0.310
L-2	1	10	10	10	10	10	10	10	10	0.175
	2	10	10	10	10	10	10	10	10	0.165
	3	10	10	10	8	8	7	7	7	0.185
L-3	1	10	10	9	9	9	9	9	9	0.270
	2	10	10	10	10	10	10	10	10	0.275
	3	10	10	10	10	10	10	10	10	0.230
L-5	1	10	10	10	10	10	10	10	10	0.245
	2	10	10	10	10	10	10	10	10	0.330
	3	10	10	10	10	10	9	9	9	0.230
L-6	1	10	10	10	9	9	8	8	8	0.255
	2	10	10	10	10	10	10	10	10	0.260
	3	10	10	10	10	10	10	10	10	0.260
L-7	1	10	10	10	10	10	10	10	10	0.340
	2	10	10	10	10	10	10	10	10	0.355
	3	10	10	10	10	10	10	10	10	0.300

TABLE 6

FATHEAD MINNOW LARVAE - ENVIRONMENTAL MONITORING
Santa Clara Valley NPS Sample #3774

Dissolved Oxygen (mg/1)

	Day 1		Day 2		Day 3		Day 4		Day 5		Day 6		Day 7	
Sample	i*	f*	i	f	i	f	i	f	i	f	i	f	i	f
Control	7.6	6.7	7.4	5.9	7.5	6.3	7.5	6.7	7.6	6.4	7.7	5.2	7.6	5.1
S-1	9.1	6.6	8.6	5.5	8.6	5.8	9.0	6.5	9.0	6.0	8.5	4.9	9.4	5.0
S-2	8.9	6.4	18.2	4.5	7.9	5.6	8.4	6.5	8.3	5.9	7.5	4.5	8.2	5.1
L-2	8.7	6.7	8.0	5.5	7.9	5.3	8.7	6.3	8.1	6.2	7.4	5.4	8.0	5.0
L-3	8.4	6.6	8.0	5.4	8.3	5.6	9.0	6.5	8.8	5.8	8.1	4.6	9.3	4.8
L-5	9.7	6.5	8.8	5.2	8.9	5.3	9.5	6.4	9.4	5.9	8.7	4.9	9.3	4.9
L-6	7.4	6.4	7.4	4.9	7.1	5.4	7.5	6.3	7.3	5.7	7.2	4.5	7.8	5.0
L-7	9.8	6.7	8.3	5.5	9.6	6.1	9.4	6.8	9.4	6.2	9.8	5.1	9.8	5.7

*i = initial f= final (just before renewal)

pH Value (units)

Sample	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
Control	7.9	8.0	8.2	8.0	7.9	8.0	8.0
S-1	7.1	7.0	7.1	6.8	6.9	6.9	6.7
S-2	7.3	7.3	7.3	7.1	7.0	7.2	7.1
L-2	7.0	6.9	6.8	6.8	6.6	6.7	6.6
L-3	6.7	6.8	6.5	6.4	6.4	6.3	6.3
L-5	6.8	6.7	6.8	6.7	6.8	6.5	6.4
L-6	6.7	6.7	6.7	6.6	6.7	6.6	6.5
L-7	7.8	7.8	8.0	7.8	7.8	7.6	7.6

TABLE 6 - continued

FATHEAD MINNOW LARVAE - ENVIRONMENTAL MONITORING
Santa Clara Valley NPS Sample #3774

Conductivity (umhos/cm)

Sample	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
Control	330	300	300	305	300	310	305
S-1	145	145	147	145	146	148	146
S-2	140	140	145	140	142	140	145
L-2	80	80	80	82	80	80	80
L-3	55	55	58	58	57	55	58
L-5	90	90	80	80	85	80	85
L-6	70	70	72	73	70	72	70
L-7	360	360	350	360	340	360	360

Temperature (°C)

Sample	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
Control	25.5	26	26	26	26	25	25.5
S-1	26	26	26	25	25.5	25	25.5
S-2	26	26	26	24.8	25.5	25	25.5
L-2	26	26	26	24.8	25.5	25	25.5
L-3	26	26	26.5	25	25.5	25	25.5
L-5	26	26	26.5	25	25.5	25	25.5
L-6	26	26	26.5	24.5	25.5	25	25.5
L-7	26	26	26.5	24	25.5	25	25.5

TABLE 6 - continued

FATHEAD MINNOW LARVAE - ENVIRONMENTAL MONITORING
Santa Clara Valley NPS Sample #3774

Alkalinity/Hardness (as mg/l CaCO3)

Sample	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
Control	87/120	87/120	87/120	87/120	87/120	87/120	87/120
S-1	48/46	48/46	48/46	48/46	48/46	48/46	48/46
S-2	52/60	52/60	52/60	52/60	52/60	52/60	52/60
L-2	35/40	35/40	35/40	35/40	35/40	35/40	35/40
L-3	35/24	35/24	35/24	35/24	35/24	35/24	35/24
L-5	42/32	42/32	42/32	42/32	42/32	42/32	42/32
L-6	47/28	47/28	47/28	47/28	47/28	47/28	47/28
L-7	155/176	155/176	155/176	155/176	155/176	155/176	155/176

TABLE 7

SELENASTRUM CAPRICORNUTUM
GROWTH AND ENVIRONMENTAL MONITORING DATA
Santa Clara Valley NPS Sample #3774- Run #1

	Cells/ml X 10^6 after 96 hours			
Sample	Replicate 1	Replicate 2	Replicate 3	Mean
Control	2.46	2.59	2.34	2.46
L-4	1.43	1.59	1.67	1.56
L-5	1.17	1.07	0.95	1.06
L-6	0.0066	0.0178	0.0089	0.0111
L-7	2.12	2.23	2.17	2.17

Bartlett's B (calculated) = 8.941
Tabled X^2 value (p=0.01, df=4) = 13.28

ANOVA F (calculated) = 3.0
ANOVA F (tabled) = 3.48

Temperature (°C)

Sample	Day 1	Day 2	Day 3	Day 4
Control	24.4	24.8	24.6	23.9
L-4	24.4	24.8	24.6	23.9
L-5	24.4	24.8	24.6	23.9
L-6	24.4	24.8	24.6	23.9

Initial pH Value and Conductivity

Sample	pH value	Conductivity (umhos/cm)
Control	7.5	300
L-4	8.0	1500
L-5	7.0	90
L-6	6.9	70
L-7	8.0	360

TABLE 8

SELENASTRUM CAPRICORNUTUM
GROWTH AND ENVIRONMENTAL MONITORING DATA
Santa Clara Valley NPS Sample #3774

Sample	Cells/ml X 10^6 after 96 hours Replicate 1	Replicate 2	Replicate 3	Mean
Control	2.93	2.93	2.89	2.92
S-1	2.56	2.57	2.53	2.55
S-2	2.28	2.12	2.85	2.42
S-4	1.47	0.99	1.23	1.23
L-2	1.06	1.21	1.19	1.15
L-3	3.83	4.47	3.80	4.03

Bartlett's B (calculated) = 15.58
Tabled X^2 value (p=0.01, df=5) = 15.01

ANOVA F (calculated) = 65.5
ANOVA F (tabled) = 3.11

Temperature (°C)

Sample	Day 1	Day 2	Day 3	Day 4
Control	25.1	24.1	25.5	25.4
S-1	25.1	24.1	25.5	25.4
S-2	25.1	24.1	25.5	25.4
S-4	25.1	24.1	25.5	25.4
L-2	25.1	24.1	25.5	25.4
L-3	25.1	24.1	25.5	25.4

TABLE 8 - continued

SELENASTRUM CAPRICORNUTUM
GROWTH AND ENVIRONMENTAL MONITORING DATA
Santa Clara Valley NPS Sample #3774 Run #2

Initial pH Value and Conductivity

Sample	pH value	Conductivity (umhos/cm)
Control	7.5	300
S-1	7.1	145
S-2	7.4	140
S-4	7.7	650
L-2	7.1	80
L-3	6.8	55

APPENDIX A

Summary of Test Conditions

TABLE A-1

Ceriodaphnia Bioassay

Test Type: Static Daily Renewal
Test Endpoints: Survival, Reproduction
Test Duration: 7 days - 168 hours
Temperature: 25 ± 1°C
Photoperiod: 16 L: 8 D
Start: 28 March, 1989, 10:00 hours
Finish: 4 April, 1989, 10:00 hours

Test Containers: 1 oz plastic cups
Test Volume: 15 ml
Dilution Water: Not Applicable

Test Material: Santa Clara Valley NPS - Wet Weather #3
Test Concentrations: 100%, 50%, 25%, controls
Replicates: 10
Organisms per replicate: 1

Test Species: *Ceriodaphnia dubia*
Source: in-house culture
Age: 4-8 hours
Acclimation/Culture Water: EPA Moderately Hard (Milli-Q)
Diet: Selenastrum, *Ceriodaphnia* chow

TABLE A-2

Fathead Minnow Bioassay

Test Type:	Static Daily Renewal
Test Endpoints:	Survival, Growth
Test Duration:	7 days - 168 hours
Temperature:	25 ± 1°C
Photoperiod:	16 L: 8 D
Start:	28 March, 1989, 11:00 hours
Finish:	4 April, 1989, 11:00 hours
Test Containers:	1 liter glass jars
Test Volume:	500 ml
Dilution Water:	Not Applicable
Test Material:	Santa Clara Valley NPS - Wet Weather #3
Test Concentrations:	100%, control
# Replicates:	3
Organisms per replicate:	10
Test Species:	*Pimephales promelas* (Fathead minnow)
Source:	in-house culture
Age:	<24 hours
Culture Water:	Dechlorinated Tap
Diet:	*Artemia* nauplii

TABLE A-3

Selenastrum Bioassay

Test Type:	Static
Test Endpoints:	Growth, (cell number)
Test Duration:	4 days, 96 hours
Temperature:	24 ± 2°C
Photoperiod:	Continuous light
Light Intensity:	400 ± 40 FC
Start:	30 March, 1989, 10:00 and 14:00 hours
Finish:	3 April, 1989, 10:00 and 14:00 hours
Test Containers:	250 ml Erlenmeyer flasks
Test Volume:	100 ml
Dilution Water:	Not Applicable
Test Material:	Santa Clara Valley NPS - Wet Weather #3
Test Concentrations:	100%, Control
# Replicates:	3
Organisms per replicate:	10,000/ml innoculated
Test Species:	*Selenastrum capricornutum*
Source:	In-house culture
Age:	4 days
Culture Water:	EPA Moderately Hard

E.2

DRY-WEATHER TOXICITY DATA

MARINE BIOASSAY LABORATORIES
1234 HIGHWAY ONE
WATSONVILLE, CA 95076
(408) 724-4522

3 SPECIES BIOASSAY RESULTS:

SANTA CLARA VALLEY NON-POINT SOURCE PROGRAM

DRY WEATHER TEST #1

SAMPLES RECEIVED 12 DECEMBER, 1988 AND THEREAFTER

Prepared for

KINNETIC LABORATORIES, INC.
Santa Cruz, California

Prepared by

MARINE BIOASSAY LABORATORIES DIVISION
TOXSCAN, INC.
Watsonville, California

JANUARY 9, 1989

MBL
A DIVISION OF TOXSCAN, INC.

Introduction

As part of the Santa Clara Valley Non-Point Source Program, toxicity testing must be carried out on water samples collected during both dry weather (four times) and wet weather (twice). Dry weather tests require daily collection of water samples at the four stream stations (S1-S4). Wet weather tests will be conducted using a single composite sample of runoff water for the daily renewals. This test is the first of four dry weather tests. Three toxicity tests are conducted, utilizing *Ceriodaphnia dubia* (invertebrate), *Pimephales promelas* (fish) and *Selenastrum capricornutum* (plant).

The *Ceriodaphnia* and *Pimephales* tests are seven days in duration, and are static-renewal protocols, requiring daily replacement of test solutions with newly-collected test water samples. Daily collections of stream water are made by MBL personnel.

The three bioassays were performed concurrently. Daphnids and fish were run on 13-20 December,1988 while algae were tested on 13-17 December, 1988. Methods, results and data are presented in the following pages.

The samples were collected and delivered to MBL by MBL personnel. The experimental design called testing only undiluted (100%) stream water. A lab water control (EPA moderately-hard) was run to provide quality assurance data. The lab water results were also used as the comparative data for statistical comparisons.

Methods

Ceriodaphnia

Test organisms were neonates derived from in-house cultures. Original broodstock was from EPA Duluth, received 11 May, 1988 and cultured in EPA moderately hard water prepared with Milli-Q water. Samples of stream test water were collected daily during the test, and lab control water was EPA moderately hard (Milli-Q).

The test was initiated with 4-8 hour old neonates derived from third broods of individually maintained broodstock. Testing was conducted with 10 individuals per treatment, each in individual plastic cups containing 15 ml of test solution. Test temperature was 25 ± 1°C and photoperiod was 16 hour light:8 hour dark. Test solutions were renewed daily, concurrent with transfers, water quality measurements and assessment of survival and reproduction. At each daily transfer, new media were inoculated with food (2 drops of *Ceriodaphnia* chow and 1 drop of *Selenastrum* culture, density approximately 2.5×10^6 cells/ml). Following the 7-day test period, survival data was statistically evaluated using the probit method to calculate the 96-hour LC50. Reproductive data was evaluated using ANOVA and Dunnett's Test after confirming data homogeneity by Bartlett's Test. Test conditions and organism data are summarized in Appendix Table A-1.

Fathead Minnow Larvae

Test organisms were larvae, less than 24 hours old, obtained from in-house culture. All larvae were from the same spawning substrate, but probably from multiple spawns. Original broodstock was purchased from Thomas Fish Farms, San Rafael, California, approximately March of 1988. Stream test water samples were collected fresh each day. Control water was EPA moderately hard (Milli-Q). Ten larvae were used in each test container and there were three replicate containers per concentration. Each larval container was fed three times daily with 750-1000 newly-hatched *Artemia* nauplii. Test temperature was 25 ± 1°C, and photoperiod was 16:8. Daily renewal of 80% of the test volume coincided with daily environmental monitoring and assessment of survival. After seven days of exposure, the test was terminated by addition of formalin to each container. Surviving larvae were dried and weighed, and weight data were statistically evaluated using Bartlett's Test followed by ANOVA and Dunnett's Test. Probit analysis of survival data was used to calculate the 96-hour LC_1. Test conditions and organism data are summarized in appendix Table A-2.

Selenastrum

Algal assays were conducted in sterile 250 ml Erlenmeyer flasks. Preparation of the nutrient medium followed guidelines set forth in EPA-600/9-78-018.

All algal counts were made manually with a hemacytometer and microscope. Treatment groups and controls were set up with a minimum of three replicates. Testing was conducted in an environmental chamber with continuous illumination of 400 ft/candles at 24 ± 2°C for 96 hours. All test flasks were innoculated with approximately 1 X 10^4 cells/ml from a 4 day old stock culture. Cultures were shaken twice daily by hand. Upon conclusion of testing, statistical analyses were made of final cell densities to determine EC50 concentrations using the Probit Method. Bartlett's test was used to confirm homogeneity of variance after which Dunnett's test was used.

Results and Conclusions

Ceriodaphnia

Reproduction and survival data for Ceriodaphnia are summarized in Table 1, and are presented in full in Table 2. Data were statistically analyzed using the laboratory water as the comparative datum ("control").

No stream sample produced $\geq$ 50% mortality of Ceriodaphnia after 96 hours exposure. The 96-hour LC_{50} for Ceriodaphnia is >100% for all samples.

Reproduction data were determined to be homogeneous by Bartlett's test, with a B value of 0.5476. Tabled X^2 value for 4 d.f. at $p=0.05$ was 9.488. ANOVA and Dunnett's test were performed on the untransformed reproduction data. For these data, the minimum significant difference is 8.15 young per adult, representing a 45.3% reduction of mean young production from control levels. There was no significant reduction in young produced between any stream water and the lab water controls.

Environmental monitoring data are tabulated and presented in Table 3.

Fathead Minnow Larvae

Survival and growth (dry weight) data are summarized in Table 4, and data for individual replicate test containers are presented in Table 5.

There was no effluent concentration tested in which survival was less than 83%. The 96-hour LC_{50} values, therefore, are >100% for all samples.

Larval weight data were determined to be homogeneous, with a Bartlett's B value of 4.674. The tabled X^2 value for 4 d.f. at $p=0.05$ is 9.488. Subsequent ANOVA and Dunnetts analyses were done on the untransformed weight data. There was no significant decrease in mean larval weight in samples S-1, S-2 and S-3 when compared with the weight of dilution water controls. There was significantly decreased larval weight in the S-4 sample.

Environmental monitoring data for fathead minnow larvae are summarized in Table 6.

Selenastrum

Growth and environmental monitoring data are summarized in Table 7.

The lab water growth (cell number) data were set equal to 100% growth, and cell numbers in each stream sample were transformed to percentage of the lab water values. The 96-hour EC_{50} was calculated to be >100% of all stream samples.

Cell number data were homogeneous (Bartletts B = 0.9274 vs tabled X^2 value at p=0.05 and 4 d.f. = 9.488). ANOVA and Dunnetts analyses were done on the untransformed data. There was no signficant decrease in mean cell numbers in any of the stream samples when compared with growth in lab water controls.

TABLE 1

SUMMARY OF REPRODUCTION AND SURVIVAL FOR *CERIODAPHNIA*
Santa Clara Valley NPS Sample #3334

Sample	Total Young Produced/Replicate a	b	c	d	e	f	g	h	i	j	% Survival (n = 10)
Control	M	14	25	11	13	M	27	M	16	20	100
S-1	M	14	11	30	16	14	M	25	24	15	100
S-2	14	30	14	15	13	28	20	M	26	21	100
S-3	26	14	31	31	M	M	24	13	12	18	100
S-4	14	25	M	11	M	13	27	16	20	M	100

M = Male

For Reproductive Data

Bartlett's B (calculated) = 0.5476
Tabled X^2 value (p=0.05, df=4) = 9.488

ANOVA F (calculated) = 0.326
ANOVA F (table) = 2.65

TABLE 2

CERIODAPHNIA REPRODUCTION AND SURVIVAL

Santa Clara Valley NPS Sample #3334

Sample	Day #	Replicate a	b	c	d	e	f	g	h	i	j	Total Young	# Live Adults
Control	4	M	0	4	0	3	M	4	M	0	2	13	10
	5	-	4	10	2	0	-	0	-	6	8	30	10
	6	-	0	0	0	4	-	9	-	4	0	17	10
	7	-	10	11	9	6	-	14	-	6	10	66	10
S-1	4	M	0	0	4	0	0	M	4	6	0	14	10
	5	-	4	3	0	4	4	-	0	2	5	22	10
	6	-	10	8	10	12	1	-	10	10	10	71	10
	7	-	0	0	16	0	9	-	11	6	0	42	10
S-2	4	0	4	0	0	0	0	4	M	4	0	12	10
	5	4	0	4	4	4	4	0	-	6	4	30	10
	6	10	12	10	11	9	10	6	-	6	7	83	10
	7	0	14	0	0	0	14	10	-	10	10	58	10
S-3	4	4	0	4	4	M	M	4	0	0	0	16	10
	5	0	6	0	0	-	-	0	4	4	6	20	10
	6	8	8	10	12	-	-	7	0	8	8	61	10
	7	14	0	17	15	-	-	13	9	0	4	72	10
S-4	4	0	4	M	0	M	0	0	0	0	M	4	10
	5	4	0	-	4	-	4	4	4	4	-	24	10
	6	10	10	-	0	-	9	10	9	9	-	56	10
	7	0	11	-	7	-	0	13	3	7	-	41	10

M = Male

TABLE 3

CERIODAPHNIA - ENVIRONMENTAL MONITORING
Santa Clara Valley NPS Sample #3334

Dissolved Oxygen (mg/l)

	Day 1		Day 2		Day 3		Day 4		Day 5		Day 6		Day 7	
Sample	i*	f*	i	f	i	f	i	f	i	f	i	f	i	f
Control	8.1	7.9	8.2	8.2	8.0	8.0	8.3	8.0	8.4	8.3	8.2	8.0	8.6	7.1
S-1	9.4	7.9	9.3	8.2	8.6	8.1	9.4	8.0	9.5	8.4	9.0	7.9	9.8	6.9
S-2	9.4	7.9	9.7	8.0	8.8	8.0	9.4	8.0	9.4	8.4	9.5	7.9	9.4	7.2
S-3	8.6	7.9	9.0	8.0	8.6	8.0	9.2	8.0	9.3	8.4	9.5	7.9	9.3	7.1
S-4	8.5	7.9	9.1	8.2	8.6	8.1	9.0	8.1	9.3	8.4	8.5	8.0	8.6	7.1

*i = initial
f = final (just before renewal)

pH Value (units)

Sample	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
Control	8.1	7.9	8.0	7.9	8.0	7.8	8.1
S-1	8.6	7.9	8.1	8.2	8.2	8.2	8.2
S-2	8.6	8.0	8.2	8.4	8.5	8.1	8.2
S-3	8.4	8.1	8.2	8.2	8.2	8.1	8.2
S-4	8.3	7.9	8.2	8.1	8.0	8.1	8.1

TABLE 3 - continued

CERIODAPHNIA - ENVIRONMENTAL MONITORING
Santa Clara Valley NPS Sample #3334

Conductivity (umhos/cm)

Sample	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
Control	340	335	320	350	345	340	330
S-1	750	775	800	800	790	790	790
S-2	1100	1150	1100	1100	1100	1250	1250
S-3	800	800	700	800	800	900	900
S-3	1425	1400	1500	1450	1450	1425	1425

Temperature (°C)

Sample	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
Control	25.0	25.5	24.5	24.5	24.0	25.0	24.0
S-1	25.0	25.5	24.5	24.5	24.0	25.0	24.0
S-2	25.0	25.5	24.5	24.5	24.0	25.0	24.0
S-3	25.0	25.5	24.5	24.5	24.0	25.0	24.0
S-4	25.0	25.5	24.5	24.5	24.0	25.0	24.0

Alkalinity/Hardness (as mg/l $CaCO_3$)

Sample	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
Control	82/114	80/110	75/110	68/105	70/108	70/110	72/110
S-1	192/238	200/210	165/215	220/255	210/245	210/245	210/245
S-2	392/572	390/525	350/518	360/520	350/520	355/525	360/518
S-3	308/390	300/350	210/305	275/328	290/335	300/320	300/338
S-4	532/495	520/440	505/445	450/460	465/455	455/450	470/465

TABLE 4

FATHEAD MINNOW LARVAE
MEAN PERCENT SURVIVAL (n=30) AND MEAN LARVAL DRY WEIGHT

Santa Clara Valley NPS Sample #3334

Sample	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	(mg) Mean Larval Dry Weight
Control	100	100	100	100	100	100	100	0.4067
S-1	100	100	100	100	100	100	97	0.4037
S-2	100	100	100	90	87	83	83	0.3606
S-3	100	100	100	100	100	100	97	0.4022
S-4	100	100	100	97	93	93	90	0.3428

For Larval Weight Data

Bartlett's B = 4.674
Tabled X^2 value (p=0.05, 4 df) = 9.488

ANOVA F (calculated) = 4.955
ANOVA F (tabled) = 3.48

TABLE 5

FATHEAD MINNOW LARVAE
SURVIVAL AND LARVAL DRY WEIGHT DATA

Santa Clara Valley NPS Sample #3334

Sample	Replicate	Number of Survivors Day 0	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Mean Larval Dry Weight (mg)
Control	1	10	10	10	10	10	10	10	10	0.4100
	2	10	10	10	10	10	10	10	10	0.4100
	3	10	10	10	10	10	10	10	10	0.4000
S-1	1	10	10	10	10	10	10	10	10	0.3800
	2	10	10	10	10	10	10	10	10	0.4200
	3	10	10	10	10	10	10	10	9	0.4111
S-2	1	10	10	10	10	9	9	9	9	0.3444
	2	10	10	10	10	10	9	8	8	0.3750
	3	10	10	10	10	8	8	8	8	0.3625
S-3	1	10	10	10	10	10	10	10	9	0.3667
	2	10	10	10	10	10	10	10	10	0.4000
	3	10	10	10	10	10	10	10	10	0.4400
S-4	1	10	10	10	10	9	8	8	8	0.3250
	2	10	10	10	10	10	10	10	10	0.3700
	3	10	10	10	10	10	10	10	10	0.3333

TABLE 6

FATHEAD MINNOW LARVAE - ENVIRONMENTAL MONITORING
Santa Clara Valley NPS Sample #3334

Dissolved Oxygen (mg/l)

Sample	Day 1		Day 2		Day 3		Day 4		Day 5		Day 6		Day 7	
	i*	f*	i	f	i	f	i	f	i	f	i	f	i	f
Control	8.1	6.8	8.2	7.2	8.0	6.5	8.3	6.7	8.4	6.8	8.2	6.2	8.6	6.8
S-1	9.4	7.1	9.3	7.1	8.6	6.6	9.4	6.5	9.5	7.0	9.0	5.8	9.8	6.5
S-2	9.4	7.3	9.7	7.2	8.8	6.6	9.4	7.1	9.4	7.3	9.5	6.9	9.4	7.1
S-3	8.6	7.2	9.0	7.0	8.6	6.7	9.2	6.9	9.3	7.0	9.5	6.3	9.3	7.1
S-4	8.5	7.0	9.1	7.1	8.6	6.6	9.0	6.9	9.3	7.1	8.5	6.0	8.6	6.6

*i = initial
f = final (just before renewal)

pH Value (units)

Sample	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
Control	8.1	7.9	8.0	7.9	8.0	7.8	8.1
S-1	8.6	7.9	8.1	8.2	8.2	8.2	8.2
S-2	8.6	8.0	8.2	8.4	8.5	8.1	8.2
S-3	8.4	8.1	8.2	8.2	8.2	8.1	8.2
S-4	8.3	7.9	8.2	8.1	8.0	8.1	8.1

TABLE 6 - continued

FATHEAD MINNOW LARVAE - ENVIRONMENTAL MONITORING
Santa Clara Valley NPS Sample #3334

Conductivity (umhos/cm)

Sample	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
Control	340	335	320	350	345	340	330
S-1	750	775	800	800	790	790	790
S-2	1100	1150	1100	1100	1100	1250	1250
S-3	800	800	700	800	800	900	900
S-3	1425	1400	1500	1450	1450	1425	1425

Temperature (°C)

Sample	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
Control	25.0	25.5	24.5	24.5	24.0	25.0	24.0
S-1	25.0	25.5	24.5	24.5	24.0	25.0	24.0
S-2	25.0	25.5	24.5	24.5	24.0	25.0	24.0
S-3	25.0	25.5	24.5	24.5	24.0	25.0	24.0
S-4	25.0	25.5	24.5	24.5	24.0	25.0	24.0

Alkalinity/Hardness (as mg/l CaCO3)

Sample	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
Control	82/114	80/110	75/110	68/105	70/108	70/110	72/110
S-1	192/238	200/210	165/215	220/255	210/245	210/245	210/245
S-2	392/572	390/525	350/518	360/520	350/520	355/525	360/518
S-3	308/290	300/350	210/305	275/328	290/335	300/320	300/338
S-4	532/495	520/440	505/445	450/460	465/455	455/450	470/465

TABLE 7

SELENASTRUM CAPRICORNUTUM
GROWTH AND ENVIRONMENTAL MONITORING DATA
Santa Clara Valley NPS Sample #3334

	Cells/ml X 10^6 after 96 hours			
Sample	Replicate 1	Replicate 2	Replicate 3	Mean
Control	1.703	2.013	2.277	1.998
S-1	3.530	3.645	3.275	3.483
S-2	4.260	4.180	3.935	4.125
S-3	2.510	2.950	2.880	2.780
S-4	2.195	1.970	1.910	2.025

Bartlett's B (calculated) = 0.9274
Tabled X^2 value (p=0.05, df=4) = 9.488

ANOVA F (calculated) = 57.08
ANOVA F (tabled) = 3.48

Temperature (°C)

Sample	Day 1	Day 2	Day 3	Day 4
Control	25.0	25.5	24.3	24.5
S-1	25.0	25.5	24.3	24.5
S-2	25.0	25.5	24.3	24.5
S-3	25.0	25.5	24.3	24.5
S-4	25.0	25.5	24.3	24.5

Initial pH Value and Conductivity

Sample	pH value	Conductivity (umhos/cm)
Control	8.1	340
S-1	8.6	750
S-2	8.6	1100
S-3	8.4	800
S-4	8.3	1425

MARINE BIOASSAY LABORATORIES
1234 HIGHWAY ONE
WATSONVILLE, CA 95076
(408) 724-4522

3 SPECIES BIOASSAY RESULTS:

SANTA CLARA VALLEY NON-POINT SOURCE PROGRAM

DRY WEATHER TEST #2

SAMPLES RECEIVED 1 FEBRUARY, 1989 AND THEREAFTER

DRAFT

Prepared for

KINNETIC LABORATORIES, INC.
Santa Cruz, California

Prepared by

MARINE BIOASSAY LABORATORIES DIVISION
TOXSCAN, INC.
Watsonville, California

APRIL, 1989

Introduction

As part of the Santa Clara Valley Non-Point Source Program, toxicity testing must be carried out on water samples collected during both dry weather (four times) and wet weather (twice). Dry weather tests require daily collection of water samples at stream stations. Wet weather tests will be conducted using a single composite sample of runoff water for the daily renewals. This test is the second of four dry weather tests. Three toxicity tests are conducted, utilizing Ceriodaphnia dubia (invertebrate), Pimephales promelas (fish) and Selenastrum capricornutum (plant).

The Ceriodaphnia and Pimephales tests are seven days in duration, and are static-renewal protocols, requiring daily replacement of test solutions with newly-collected test water samples. Daily collections of stream water were made only during the first two days of the test period. On the second day it became clear that an unexpected rainstorm was imminent, and the inclusion of storm runoff in our "dry weather" samples was not appropriate in terms of the study objectives. The decision was made, therefore, to collect enough sample on Day 2 (our last dry day) to perform daily renewals for the remainder of the 7-day test period. In summary, water collections were made only on Days 1 and 2 of the test period. Water collected on Day 2 was stored at 4°C for the remainder of the 7-day test period, and daily renewals on days 2-7 were done using this stored water.

The three bioassays were performed concurrently. Daphnids and fish were run on 3-10 February, 1989 while algae were tested on 3-7 February, 1989. Methods, results and data are presented in the following pages.

The samples were collected and delivered to MBL by MBL personnel. The experimental design called testing only undiluted (100%) stream water. A lab water control (EPA moderately-hard) was run to provide quality assurance data. The lab water results were also used as the comparative data for statistical comparisons.

Methods

Ceriodaphnia

Test organisms were neonates derived from in-house cultures. Original broodstock was from EPA Duluth, received 11 May, 1988 and cultured in EPA moderately hard water prepared with Milli-Q water. Samples of stream test water were collected daily during the test, and lab control water was EPA moderately hard (Milli-Q).

The test was initiated with 4-8 hour old neonates derived from third broods of individually maintained broodstock. Testing was conducted with 10 individuals per treatment, each in individual plastic cups containing 15 ml of test solution. Test temperature was 25 ± 1°C and photoperiod was 16 hour light:8 hour dark. Test solutions were renewed daily, concurrent with transfers, water quality measurements and assessment of survival and reproduction. At each daily transfer, new media were inoculated with food (2 drops of *Ceriodaphnia* chow and 1 drop of *Selenastrum* culture, density approximately 2.5×10^6 cells/ml). Following the 7-day test period, survival data was statistically evaluated using the probit method to calculate the 96-hour LC50. Reproductive data was evaluated using ANOVA and Dunnett's Test after confirming data homogeneity by Bartlett's Test. Test conditions and organism data are summarized in Appendix Table A-1.

Fathead Minnow Larvae

Test organisms were larvae, less than 24 hours old, obtained from in-house culture. All larvae were from the same spawning substrate, but probably from multiple spawns. Original broodstock was purchased from Thomas Fish Farms, San Rafael, California, approximately March of 1988. Stream test water samples were collected fresh each day. Control water was EPA moderately hard (Milli-Q). Ten larvae were used in each test container and there were three replicate containers per concentration. Each larval container was fed three times daily with 750-1000 newly-hatched *Artemia* nauplii. Test temperature was 25 ± 1°C, and photoperiod was 16:8. Daily renewal of 80% of the test volume coincided with daily environmental monitoring and assessment of survival. After seven days of exposure, the test was terminated by addition of formalin to each container. Surviving larvae were dried and weighed, and weight data were statistically evaluated using Bartlett's Test followed by ANOVA and Dunnett's Test. Probit analysis of survival data was used to calculate the 96-hour LC_1. Test conditions and organism data are summarized in appendix Table A-2.

Selenastrum

Algal assays were conducted in sterile 250 ml Erlenmeyer flasks. Preparation of the nutrient medium followed guidelines set forth in EPA-600/9-78-018.

All algal counts were made manually with a hemacytometer and microscope. Treatment groups and controls were set up with a minimum of three replicates. Testing was conducted in an environmental chamber with continuous illumination of 400 ft/candles at 24 ± 2°C for 96 hours. All test flasks were innoculated with approximately 1 X 10^4 cells/ml from a 4 day old stock culture. Cultures were shaken twice daily by hand. Upon conclusion of testing, statistical analyses were made of final cell densities to determine EC50 concentrations using the Probit Method. Bartlett's test was used to confirm homogeneity of variance after which Dunnett's test was used.

Results and Conclusions

Ceriodaphnia

Reproduction and survival data for Ceriodaphnia are summarized in Table 1, and are presented in full in Table 2. Data were statistically analyzed using the laboratory water as the comparative datum ("control").

Analysis of mortality data by Fisher's Exact Test showed that sample S-2 produced statistically significant mortality when compared with laboratory water controls (Fishers b value = 3). Following protocol guidance, reproduction data from S-2 were not included in subsequent statistical analyses.

Reproduction data were found to be not normally distributed (D'Agostino's D value = 0.2397). Critical D values are 0.2655 to 0.2874. Data could not be normalized by any transformation (Square root, log, or arcsin $\sqrt{x}$), and subsequent analysis was done by the non-parametric Steel's Many-One Rank Test. The tabulated critical rank sum value for n=10 and k=4 is 76. Rank sums for S-1, S-3, S-4 and S-5 all exceeded 76, indicating that reproduction in these samples was not significantly lower than in the laboratory control water.

Environmental monitoring data are tabulated and presented in Table 3.

Fathead Minnow Larvae

Survival and growth (dry weight) data are summarized in Table 4, and data for individual replicate test containers are presented in Table 5. There was not enough sample from S-5 to do the fathead minnow bioassay, and only S-1 through S-4 were included.

Larval weight data were determined to be normally distributed (Shpiro-Wilkes test), and homogeneous, with a Bartlett's B value of 0.979. The tabled X^2 value for 4 d.f. at p=0.01 is 13.28. Subsequent ANOVA and Dunnetts analyses were done on the untransformed weight data. There was no significant decrease in mean larval weight in samples S-1, S-2, S-3 and S-4 when compared with the weight of dilution water controls.

Environmental monitoring data for fathead minnow larvae are summarized in Table 6.

Selenastrum

Growth and environmental monitoring data are summarized in Table 7.

Cell number data were normally distributed (Shapiro-Wilkes) and homogeneous (Bartletts B = 0.9274 vs tabled X^2 value at p=0.01 and 5 d.f.

= 15.09). ANOVA and Dunnetts analyses were done on the untransformed data. There was no signficant decrease in mean cell numbers in any of the stream samples when compared with growth in lab water controls. There were significantly increased cell numbers in samples S-2, S-3 and S-5.

TABLE 1

SUMMARY OF REPRODUCTION AND SURVIVAL FOR *CERIODAPHNIA*
Santa Clara Valley NPS Sample #3533

	Total Young Produced/Replicate										% Survival
Sample	a	b	c	d	e	f	g	h	i	j	(n = 10)
Control	18	17	23	19	18	19	18	20	12	14	100
S-1	35	34	39	34	34	41	39	34	28	33	100
S-2	6*	0*	0	0*	8*	0*	6	0*	3	4*	30
S-3	29	29	30	32	12	32	29	32	28	25	100
S-4	37	41	28	35	3	29	32	32	27	33	100
S-5	29	16	28	16	26	19	25	28	26	27	100

* = Adult died prior to test completion

For Survival Data

Fisher's Exact Test - Critical b value = 6
- b value for sample S-2 = 3

For Reproductive Data

D'Agostino's D (calculated) = 0.2397*
Critical D interval (tabled) = 0.2655-0.2874

Steel's Critical Rank Sum = 76
Steel's Rank Sum for all samples = >76

* Data were not mormally distributed and could not be normalized by transformation. Data were analyzed by Steel's Many-One Rank Test.

TABLE 2

CERIODAPHNIA REPRODUCTION AND SURVIVAL

Santa Clara Valley NPS Sample #3533

Sample	Day #	Replicate										Total Young	# Live Adults
		a	b	c	d	e	f	g	h	i	j		
Control	4	0	0	0	3	3	0	2	4	0	0	12	10
	5	6	5	5	0	3	6	0	7	4	3	39	10
	6	0	5	8	7	6	6	6	0	0	2	40	10
	7	12	7	10	9	6	7	10	9	8	9	87	10
S-1	4	6	7	7	7	7	6	6	5	2	5	58	10
	5	0	0	0	0	0	0	0	0	0	0	0	10
	6	13	10	12	10	11	15	13	11	11	11	117	10
	7	16	17	20	17	16	20	20	18	15	17	176	10
S-2	4	6	X	0	X	0	0	4	X	3	2	15	7
	5	0	-	0	-	4	X	0	-	0	0	4	6
	6	0	-	0	-	4	-	2	-	0	2	8	6
	7	X	-	0	-	X	-	0	-	0	X	0	3
S-3	4	5	6	6	6	1	6	4	5	4	1	44	10
	5	0	0	0	0	3	0	0	0	0	3	6	10
	6	10	8	10	10	8	11	10	11	9	9	96	10
	7	14	15	14	16	0	15	15	16	15	12	132	10
S-4	4	6	5	0	6	0	5	5	6	5	6	44	10
	5	0	0	0	0	0	0	0	0	0	0	0	10
	6	12	15	11	11	3	9	10	11	9	11	102	10
	7	19	21	17	18	0	15	17	15	13	16	151	10
S-5	4	6	4	6	0	6	4	5	4	5	0	40	10
	5	0	0	0	6	0	0	0	0	0	4	10	10
	6	9	12	9	10	11	8	10	9	8	8	94	10
	7	14	0	13	0	9	7	10	15	13	15	96	10

X = Adult Died

TABLE 3

CERIODAPHNIA - ENVIRONMENTAL MONITORING
Santa Clara Valley NPS Sample #3533

Dissolved Oxygen (mg/l)

	Day 1		Day 2		Day 3		Day 4		Day 5		Day 6		Day 7	
Sample	i*	f*	i	f	i	f	i	f	i	f	i	f	i	f
Control	7.7	7.5	8.5	7.9	8.3	8.0	8.0	7.8	8.8	8.2	8.0	8.1	8.8	7.2
S-1	9.3	7.4	9.4	7.8	7.2	7.9	9.4	7.8	9.1	7.8	9.9	7.1	9.9	6.7
S-2	10.0	7.4	10.4	7.9	9.8	7.9	10.1	7.8	10.2	8.0	10.6	7.4	10.8	6.4
S-3	8.2	7.4	10.4	7.8	10.0	7.9	9.6	7.7	9.6	7.9	10.6	7.5	10.6	6.8
S-4	7.8	7.4	8.9	7.8	8.8	7.9	8.9	7.6	9.4	7.9	10.2	7.4	10.2	7.2
S-5	8.5	7.4	10.4	7.8	10.0	7.9	9.6	7.7	9.6	7.9	10.6	7.5	10.6	6.8

*i = initial
f = final (just before renewal)

pH Value (units)

Sample	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
Control	7.8	7.4	7.9	.99	8.0	7.9	8.0
S-1	9.0	8.6	8.8	8.8	8.8	8.6	8.4
S-2	8.3	8.3	8.5	8.5	8.5	8.4	8.2
S-3	8.2	8.3	8.4	8.4	8.4	8.4	8.1
S-4	8.0	8.0	8.0	8.0	8.1	8.0	7.7
S-5	8.2	8.3	8.4	8.4	8.4	8.4	8.1

TABLE 3 - continued

CERIODAPHNIA - ENVIRONMENTAL MONITORING
Santa Clara Valley NPS Sample #3533

Conductivity (umhos/cm)

Sample	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
Control	280	280	---	---	---	---	---
S-1	530	1180	---	---	---	---	---
S-2	1090	1060	---	---	---	---	---
S-3	775	795	---	---	---	---	---
S-4	1320	1100	---	---	---	---	---
S-5	750	795	---	---	---	---	---

Temperature (°C)

Sample	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
Control	25.0	24.0	24.0	24.0	24.0	24.0	24.0
S-1	24.0	24.5	24.5	24.5	25.0	25.0	25.0
S-2	24.0	24.5	24.5	24.5	25.0	25.0	25.0
S-3	24.0	24.5	24.5	24.5	25.0	25.0	25.0
S-4	24.0	24.5	24.5	24.5	25.0	25.0	25.0
S-5	24.0	24.5	24.5	24.5	25.0	25.0	25.0

Alkalinity/Hardness (as mg/l CaCO3)

Sample	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
Control	76/102	76/102	---	---	---	---	---
S-1	180/224	---	---	---	---	---	---
S-2	368/530	---	---	---	---	---	---
S-3	280/370	---	---	---	---	---	---
S-4	472/454	---	---	---	---	---	---
S-5	280/370	---	---	---	---	---	---

TABLE 4

FATHEAD MINNOW LARVAE
MEAN PERCENT SURVIVAL (n=30) AND MEAN LARVAL DRY WEIGHT

Santa Clara Valley NPS Sample #3533

Sample	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	(mg) Mean Larval Dry Weight
Control	100	100	100	100	100	97	93	0.4147
S-1	100	100	100	100	100	100	97	0.3537
S-2	100	100	100	97	97	87	87	0.3923
S-3	100	100	100	100	100	87	83	0.4220
S-4	100	100	100	100	100	97	90	0.4477

For Larval Weight Data

Bartlett's B = 0.979
Tabled X^2 value (p=0.01, 4 df) = 13.28

ANOVA F (calculated) = 4.08
ANOVA F (tabled) = 3.48

TABLE 5

FATHEAD MINNOW LARVAE
SURVIVAL AND LARVAL DRY WEIGHT DATA

Santa Clara Valley NPS Sample #3533

		Number of Survivors								Mean Larval Dry
Sample	Replicate	Day 0	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Weight (mg)
Control	1	10	10	10	10	10	10	10	9	0.4000
	2	10	10	10	10	10	10	9	9	0.4440
	3	10	10	10	10	10	10	10	10	0.4000
S-1	1	10	10	10	10	10	10	10	9	0.3770
	2	10	10	10	10	10	10	10	10	0.3540
	3	10	10	10	10	10	10	10	10	0.3300
S-2	1	10	10	10	10	10	10	10	10	0.3900
	2	10	10	10	10	9	9	8	8	0.4370
	3	10	10	10	10	8	8	8	8	0.3500
S-3	1	10	10	10	10	10	10	10	9	0.4110
	2	10	10	10	10	10	10	9	9	0.4550
	3	10	10	10	10	10	10	7	7	0.4000
S-4	1	10	10	10	10	10	10	10	9	0.4770
	2	10	10	10	10	10	10	9	9	0.4330
	3	10	10	10	10	10	10	10	9	0.4330

TABLE 6

FATHEAD MINNOW LARVAE - ENVIRONMENTAL MONITORING
Santa Clara Valley NPS Sample #3533

Dissolved Oxygen (mg/l)

	Day 1		Day 2		Day 3		Day 4		Day 5		Day 6		Day 7	
Sample	i*	f*	i	f	i	f	i	f	i	f	i	f	i	f
Control	7.7	7.4	8.5	7.5	8.3	7.6	8.0	7.0	8.8	7.0	8.0	6.7	8.8	6.6
S-1	9.3	7.3	9.4	7.3	7.2	7.2	9.4	6.7	9.1	7.1	9.9	7.3	9.9	6.8
S-2	10.0	7.6	10.4	7.5	9.8	7.4	10.1	7.1	10.2	7.5	10.6	7.0	10.8	7.1
S-3	8.2	7.5	10.4	7.3	10.0	7.2	9.6	6.4	9.6	7.1	10.6	6.9	10.6	7.0
S-4	7.8	7.2	8.9	7.2	8.8	7.0	8.9	6.4	9.4	7.0	10.2	6.6	10.2	6.5

*i = initial
f = final (just before renewal)

pH Value (units)

Sample	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
Control	7.8	7.4	7.9	.99	8.0	7.9	8.0
S-1	9.0	8.6	8.8	8.8	8.8	8.6	8.4
S-2	8.3	8.3	8.5	8.5	8.5	8.4	8.2
S-3	8.2	8.3	8.4	8.4	8.4	8.4	8.1
S-4	8.0	8.0	8.0	8.0	8.1	8.0	7.7
S-5	8.2	8.3	8.4	8.4	8.4	8.4	8.1

TABLE 6 - continued

FATHEAD MINNOW LARVAE - ENVIRONMENTAL MONITORING
Santa Clara Valley NPS Sample #3533

Conductivity (umhos/cm)

Sample	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
Control	280	280	---	---	---	---	---
S-1	530	1180	---	---	---	---	---
S-2	1090	1060	---	---	---	---	---
S-3	775	795	---	---	---	---	---
S-4	1320	1100	---	---	---	---	---
S-5	750	795	---	---	---	---	---

Temperature (°C)

Sample	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
Control	25.0	24.0	24.0	24.0	24.0	24.0	24.0
S-1	24.0	24.5	24.5	24.5	25.0	25.0	25.0
S-2	24.0	24.5	24.5	24.5	25.0	25.0	25.0
S-3	24.0	24.5	24.5	24.5	25.0	25.0	25.0
S-4	24.0	24.5	24.5	24.5	25.0	25.0	25.0
S-5	24.0	24.5	24.5	24.5	25.0	25.0	25.0

Alkalinity/Hardness (as mg/l CaCO3)

Sample	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
Control	76/102	76/102	---	---	---	---	---
S-1	180/224	---	---	---	---	---	---
S-2	368/530	---	---	---	---	---	---
S-3	280/370	---	---	---	---	---	---
S-4	472/454	---	---	---	---	---	---
S-5	280/370	---	---	---	---	---	---

TABLE 7

SELENASTRUM CAPRICORNUTUM
GROWTH AND ENVIRONMENTAL MONITORING DATA
Santa Clara Valley NPS Sample #3533

	Cells/ml X 10^6 after 96 hours			
Sample	Replicate 1	Replicate 2	Replicate 3	Mean
Control	2.59	2.66	2.61	2.62
S-1	2.41	2.67	2.66	2.58
S-2	5.06	5.04	5.40	5.17
S-3	2.90	3.33	3.68	3.30
S-4	2.13	2.17	2.08	2.13
S-5	3.20	3.58	4.40	3.73

Bartlett's B (calculated) = 14.83
Tabled X^2 value (p=0.01, df=5) = 15.09

ANOVA F (calculated) = 36.39
ANOVA F (tabled) = 3.11

Temperature (°C)

Sample	Day 1	Day 2	Day 3	Day 4
Control	25.6	25.1	25.0	25.8
S-1	25.6	25.1	25.0	25.8
S-2	25.6	25.1	25.0	25.8
S-3	25.6	25.1	25.0	25.8
S-4	25.6	25.1	25.0	25.8
S-5	25.6	25.1	25.0	25.8

Initial pH Value and Conductivity

Sample	pH value	Conductivity (umhos/cm)
Control	7.9	280
S-1	8.8	480
S-2	8.5	1060
S-3	8.4	795
S-4	8.0	1100
S-5	8.5	795

APPENDIX A

Summary of Test Conditions

TABLE A-1

Ceriodaphnia Bioassay

Test Type:	Static Daily Renewal
Test Endpoints:	Survival, Reproduction
Test Duration:	7 days - 168 hours
Temperature:	25 ± 1°C
Photoperiod:	16 L: 8 D
Start:	3 February, 1989, 10:00 hours
Finish:	10 February, 1989, 10:00 hours
Test Containers:	1 oz plastic cups
Test Volume:	15 ml
Dilution Water:	Not Applicable
Test Material:	Santa Clara Valley NPS - Dry Weather #2
Test Concentrations:	100%, controls
# Replicates:	10
Organisms per replicate:	1
Test Species:	*Ceriodaphnia dubia*
Source:	in-house culture
Age:	4-8 hours
Acclimation/Culture Water:	EPA Moderately Hard (Milli-Q)
Diet:	Selenastrum, *Ceriodaphnia* chow

TABLE A-2

Fathead Minnow Bioassay

Test Type:	Static Daily Renewal
Test Endpoints:	Survival, Growth
Test Duration:	7 days - 168 hours
Temperature:	25 ± 1°C
Photoperiod:	16 L: 8 D
Start:	3 February, 1989, 12:00 hours
Finish:	10 February, 1989, 12:00 hours
Test Containers:	1 liter glass jars
Test Volume:	500 ml
Dilution Water:	Not Applicable
Test Material:	Santa Clara Valley NPS - Dry Weather #2
Test Concentrations:	100%, control
# Replicates:	3
Organisms per replicate:	10
Test Species:	*Pimephales promelas* (Fathead minnow)
Source:	in-house culture
Age:	<24 hours
Culture Water:	Dechlorinated Tap
Diet:	*Artemia* nauplii

TABLE A-3

Selenastrum Bioassay

Test Type:	Static
Test Endpoints:	Growth, (cell number)
Test Duration:	4 days, 96 hours
Temperature:	24 ± 2°C
Photoperiod:	Continuous light
Light Intensity:	400 ± 40 FC
Start:	3 February, 1989, 13:00 hours
Finish:	7 February, 1989, 13:00 hours

Test Containers:	250 ml Erlenmeyer flasks
Test Volume:	100 ml
Dilution Water:	Not Applicable

Test Material:	Santa Clara Valley NPS - Dry Weather #2
Test Concentrations:	100%, Control
# Replicates:	3
Organisms per replicate:	10,000/ml innoculated

Test Species:	*Selenastrum capricornutum*
Source:	In-house culture
Age:	4 days
Culture Water:	EPA Moderately Hard

MARINE BIOASSAY LABORATORIES
1234 HIGHWAY ONE
WATSONVILLE, CA 95076
(408) 724-4522

3 SPECIES BIOASSAY RESULTS:
SANTA CLARA VALLEY NON-POINT SOURCE PROGRAM
DRY WEATHER TEST #3
SAMPLES RECEIVED 7 APRIL, 1989 AND THEREAFTER

DRAFT

Prepared for

KINNETIC LABORATORIES, INC.
Santa Cruz, California

Prepared by

MARINE BIOASSAY LABORATORIES DIVISION
TOXSCAN, INC.
Watsonville, California

APRIL, 1989

MBL
A DIVISION OF TOXSCAN, INC.

Introduction

As part of the Santa Clara Valley Non-Point Source Program, toxicity testing must be carried out on water samples collected during both dry weather (four times) and wet weather (twice). Dry weather tests require daily collection of water samples at stream stations. Wet weather tests will be conducted using a single composite sample of runoff water for the daily renewals. This test is the third of four dry weather tests. Three toxicity tests are conducted, utilizing Ceriodaphnia dubia (invertebrate), Pimephales promelas (fish) and Selenastrum capricornutum (plant).

The Ceriodaphnia and Pimephales tests are seven days in duration, and are static-renewal protocols, requiring daily replacement of test solutions with newly-collected test water samples. Daily collections of stream water were made by Kinnetic Laboratories (KLI) personnel.

The three bioassays were performed concurrently. Daphnids and fish were run on 9-16 April, 1989 while algae were tested on 8-12 April, 1989. Methods, results and data are presented in the following pages.

The experimental design called for testing only undiluted (100%) stream water. A lab water control (EPA moderately-hard) was run to provide quality assurance data. The lab water results were also used as the comparative data for statistical comparisons.

Methods

Ceriodaphnia

Test organisms were neonates derived from in-house cultures. Original broodstock was from EPA Duluth, received 11 May, 1988 and cultured in EPA moderately hard water prepared with Milli-Q water. Samples of stream test water were collected daily during the test, and lab control water was EPA moderately hard (Milli-Q).

The test was initiated with 4-8 hour old neonates derived from third broods of individually maintained broodstock. Testing was conducted with 10 individuals per treatment, each in individual plastic cups containing 15 ml of test solution. Test temperature was 25 ± 1°C and photoperiod was 16 hour light:8 hour dark. Test solutions were renewed daily, concurrent with transfers, water quality measurements and assessment of survival and reproduction. At each daily transfer, new media were inoculated with food (2 drops of *Ceriodaphnia* chow and 1 drop of *Selenastrum* culture, density approximately 2.5 X 10^6 cells/ml). Following the 7-day test period, survival data was statistically evaluated using the probit method to calculate the 96-hour LC50. Reproductive data was evaluated using ANOVA and Dunnett's Test after confirming data homogeneity by Bartlett's Test. Test conditions and organism data are summarized in Appendix Table A-1.

Fathead Minnow Larvae

Test organisms were larvae, less than 24 hours old, obtained from in-house culture. All larvae were from the same spawning substrate, but probably from multiple spawns. Original broodstock was purchased from Thomas Fish Farms, San Rafael, California, approximately March of 1988. Stream test water samples were collected fresh each day. Control water was EPA moderately hard (Milli-Q). Ten larvae were used in each test container and there were three replicate containers per concentration. Each larval container was fed three times daily with 750-1000 newly-hatched *Artemia* nauplii. Test temperature was 25 ± 1°C, and photoperiod was 16:8. Daily renewal of 80% of the test volume coincided with daily environmental monitoring and assessment of survival. After seven days of exposure, the test was terminated by addition of formalin to each container. Surviving larvae were dried and weighed, and weight data were statistically evaluated using Bartlett's Test followed by ANOVA and Dunnett's Test. Probit analysis of survival data was used to calculate the 96-hour LC$_1$. Test conditions and organism data are summarized in appendix Table A-2.

Selenastrum

Algal assays were conducted in sterile 250 ml Erlenmeyer flasks. Preparation of the nutrient medium followed guidelines set forth in EPA-600/9-78-018.

All algal counts were made manually with a hemacytometer and microscope. Treatment groups and controls were set up with a minimum of three replicates. Testing was conducted in an environmental chamber with continuous illumination of 400 ft/candles at 24 ± 2°C for 96 hours. All test flasks were innoculated with approximately 1×10^4 cells/ml from a 4 day old stock culture. Cultures were shaken twice daily by hand. Upon conclusion of testing, statistical analyses were made of final cell densities to determine EC50 concentrations using the Probit Method. Bartlett's test was used to confirm homogeneity of variance after which Dunnett's test was used.

Results and Conclusions

Ceriodaphnia

Reproduction and survival data for *Ceriodaphnia* are summarized in Table 1, and are presented in full in Table 2. Data were statistically analyzed using the laboratory water as the comparative datum ("control").

Analysis of mortality data by Fisher's Exact Test showed that sample S-4 produced statistically significant mortality when compared with laboratory water controls (Fishers b value = 3). Following protocol guidance, reproduction data from S-4 were not included in subsequent statistical analyses.

Reproduction data were found to be normally distributed (D'Agostino's D test) and homogeneous (Bartlett's B = 9.81).

None of the samples produced significantly decreased young production when compared with laboratory water controls.

Environmental monitoring data are tabulated and presented in Table 3.

Fathead Minnow Larvae

Survival and growth (dry weight) data are summarized in Table 4, and data for individual replicate test containers are presented in Table 5. There was not enough sample from S-5 to do the fathead minnow bioassay, and only S-1 through S-4 were included.

Larval weight data were determined to be normally distributed (Shapiro-Wilkes test), and homogeneous, with a Bartlett's B value of 3.85. The tabled X^2 value for 4 d.f. at p=0.01 is 13.28. Subsequent ANOVA and Dunnetts analyses were done on the untransformed weight data. There was no significant decrease in mean larval weight in samples S-1, S-2, and S-4 when compared with the weight of dilution water controls. There was significantly decreased larval weight in sample S-3.

Environmental monitoring data for fathead minnow larvae are summarized in Table 6.

Selenastrum

Growth and environmental monitoring data are summarized in Table 7.

Cell number data were normally distributed (Shapiro-Wilkes) and homogeneous (Bartletts B = 5.86 vs tabled X^2 value at p=0.01 and 4 d.f. = 13.28). ANOVA and Dunnetts analyses were done on the untransformed data. There was no signficant decrease in mean cell numbers in samples S1, S2 and S3 when compared with growth in lab water controls. There were significantly decreased cell numbers in sample S-4.

TABLE 1

SUMMARY OF REPRODUCTION AND SURVIVAL FOR CERIODAPHNIA
Santa Clara Valley NPS Sample #3838

Sample	Total Young Produced/Replicate										% Survival
	a	b	c	d	e	f	g	h	i	j	(n = 10)
Control	16	19	20	19	22	15	14	17	18	17	100
S-1	28	28	9	11*	29	34	34	24	28	30	90
S-2	13	0*	18	12	15	25	23	18	11	15	80
S-3	29	31	25	28	26	31	40	14	29	19	100
S-4	28*	18	15*	15*	15*	16*	19*	15*	17*	27*	10

* = Adult died prior to test completion

For Reproductive Data

Bartlett's B (calculated) = 9.81
Tabled x^2 value (p=0.01, dF=3) = 11.35

ANOVA F (calculated) = 9.95
ANOVA F (Tabled) = 2.86

TABLE 2 **CERIODAPHNIA REPRODUCTION AND SURVIVAL**

Santa Clara Valley NPS Sample #3838

Sample	Day #	Replicate										Total Young	# Live Adults
		a	b	c	d	e	f	g	h	i	j		
Control	4	3	4	3	0	3	4	4	0	4	2	27	10
	5	0	0	2	5	4	0	1	4	0	4	20	10
	6	4	6	6	4	7	3	4	2	5	3	44	10
	7	9	9	9	10	8	8	5	11	9	8	86	10
S-1	4	3	3	4	4	5	5	4	4	3	4	39	10
	5	1	10	0	7	8	11	13	5	11	0	66	10
	6	9	0	10	X	0	0	0	0	0	13	32	9
	7	15	15	15	-	16	18	17	15	14	13	138	9
S-2	4	3	X	4	5	5	4	4	3	5	5	38	9
	5	0	-	8	5	0	11	10	7	6	0	47	9
	6	7	-	0	0	4	0	0	0	X	6	17	8
	7	3	-	6	2	6	10	9	8	-	4	48	8
S-3	4	4	4	4	4	4	4	5	3	3	4	39	10
	5	0	11	0	12	10	12	10	0	0	0	55	10
	6	10	0	10	0	0	0	10	11	12	10	63	10
	7	15	16	11	12	12	15	15	0	14	15	120	10
S-4	4	2	5	3	5	5	3	4	4	4	4	39	10
	5	11	10	12	10	10	0	0	11	13	8	85	10
	6	15	0	X	0	0	13	0	X	X	15	43	7
	7	X	3	-	X	X	X	X	-	-	X	3	1

X = Adult Died

TABLE 3

CERIODAPHNIA - ENVIRONMENTAL MONITORING
Santa Clara Valley NPS Sample #3838

Dissolved Oxygen (mg/1)

	Day 1		Day 2		Day 3		Day 4		Day 5		Day 6		Day 7	
Sample	i*	f*	i	f	i	f	i	f	i	f	i	f	i	f
Control	7.6	7.7	7.9	7.8	8.0	7.5	8.1	7.8	8.0	7.9	8.2	7.8	8.0	7.1
S-1	9.2	7.7	9.2	7.5	10.0	7.4	9.5	7.6	9.4	8.0	9.7	7.5	7.8	7.0
S-2	10.0	7.7	10.5	7.2	9.8	7.5	10.4	7.8	10.4	7.8	10.0	7.7	8.7	7.0
S-3	9.1	7.8	9.4	7.4	9.7	7.4	8.9	7.7	9.4	7.9	8.8	7.7	7.7	7.1
S-4	8.2	7.8	9.5	7.5	8.8	7.4	8.7	7.8	8.4	7.8	7.2	7.6	7.2	7.3

*i = initial
f = final (just before renewal)

pH Value (units)

Sample	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
Control	8.0	7.9	7.9	8.0	7.9	7.7	7.9
S-1	8.2	7.9	8.0	8.7	8.1	8.1	7.9
S-2	8.2	8.2	8.0	8.4	8.2	8.2	8.1
S-3	8.1	8.1	7.8	8.1	8.0	7.8	7.9
S-4	8.0	7.9	7.8	8.1	7.8	7.7	7.9

TABLE 3 - continued

CERIODAPHNIA - ENVIRONMENTAL MONITORING
Santa Clara Valley NPS Sample #3838

Conductivity (umhos/cm)

Sample	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
Control	275	250	285	310	300	270	285
S-1	700	7000	700	600	600	700	700
S-2	1100	1075	1110	1100	1100	1100	1150
S-3	780	780	790	810	740	800	840
S-4	1500	1580	1500	1550	1460	1560	1580

Temperature (°C)

Sample	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
Control	25.0	25.5	25.0	26.0	23.0	25.5	26.0
S-1	25.0	25.5	25.0	26.0	24.0	25.0	26.0
S-2	25.0	25.5	25.0	26.0	24.0	25.5	26.0
S-3	25.0	25.5	25.0	26.0	23.5	24.5	26.0
S-4	25.0	25.5	24.0	26.0	25.0	25.0	24.0

Alkalinity/Hardness (as mg/l CaCO3)

Sample	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
Control	60/100	65/100	67/100	67/100	65/100	67/102	65/102
S-1	125/215	115/218	204/218	142/184	190/190	195/210	212/208
S-2	275/475	300/485	359/550	366/590	352/625	352/584	420/580
S-3	200/320	210/320	275/330	252/344	350/304	275/336	330/294
S-4	390/425	390/435	505/450	512/432	482/440	525/460	550/440

TABLE 4

FATHEAD MINNOW LARVAE
MEAN PERCENT SURVIVAL (n=30) AND MEAN LARVAL DRY WEIGHT

Santa Clara Valley NPS Sample #3838

Sample	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	(mg) Mean Larval Dry Weight
Control	100	100	100	97	97	97	97	0.5200
S-1	100	97	97	97	97	97	97	0.4833
S-2	100	97	97	97	97	97	97	0.5100
S-3	100	100	97	97	97	97	97	0.4400
S-4	100	100	100	100	100	100	100	0.4500

For Larval Weight Data

Bartlett's B = 3.85
Tabled X^2 value (p=0.01, 4 df) = 13.28

ANOVA F (calculated) = 2.56
ANOVA F (tabled) = 3.48

TABLE 5

FATHEAD MINNOW LARVAE
SURVIVAL AND LARVAL DRY WEIGHT DATA

Santa Clara Valley NPS Sample #3838

		Number of Survivors								Mean Larval Dry
Sample	Replicate	Day 0	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Weight (mg)
Control	1	10	10	10	10	10	10	10	10	0.5100
	2	10	10	10	10	10	10	10	10	0.5200
	3	10	10	10	10	9	9	9	9	0.5300
S-1	1	10	10	10	10	10	10	10	10	0.4600
	2	10	10	9	9	9	9	9	9	0.4500
	3	10	10	10	10	10	10	10	10	0.5400
S-2	1	10	10	9	9	9	9	9	9	0.5200
	2	10	10	10	10	10	10	10	10	0.4800
	3	10	10	10	10	10	10	10	10	0.5300
S-3	1	10	10	10	9	9	9	9	9	0.4400
	2	10	10	10	10	10	10	10	10	0.4900
	3	10	10	10	10	10	10	10	10	0.3900
S-4	1	10	10	10	10	10	10	10	10	0.4900
	2	10	10	10	10	10	10	10	10	0.4500
	3	10	10	10	10	10	10	10	10	0.4100

TABLE 6

FATHEAD MINNOW LARVAE - ENVIRONMENTAL MONITORING
Santa Clara Valley NPS Sample #3838

Dissolved Oxygen (mg/l)

	Day 1		Day 2		Day 3		Day 4		Day 5		Day 6		Day 7	
Sample	i*	f*	i	f	i	f	i	f	i	f	i	f	i	f
Control	7.6	6.5	7.9	5.5	8.0	6.2	8.1	6.5	8.0	6.3	8.2	5.3	8.0	4.8
S-1	9.2	6.3	9.2	5.3	10.0	5.8	9.5	5.8	9.4	5.9	9.7	5.2	7.8	5.0
S-2	10.0	6.1	10.5	5.0	9.8	5.7	10.4	6.5	10.4	6.3	10.0	5.0	8.7	5.6
S-3	9.1	6.2	9.4	5.2	9.7	4.9	8.9	5.7	9.4	6.0	8.8	4.9	7.7	5.9
S-4	8.2	6.3	9.5	5.2	8.8	5.6	8.7	5.9	8.4	5.6	7.2	4.7	7.2	5.1

*i = initial
f = final (just before renewal)

pH Value (units)

Sample	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
Control	8.0	7.9	7.9	8.0	7.9	7.7	7.9
S-1	8.2	7.9	8.0	8.7	8.1	8.1	7.9
S-2	8.2	8.2	8.0	8.4	8.2	8.2	8.1
S-3	8.1	8.1	7.8	8.1	8.0	7.8	7.9
S-4	8.0	7.9	7.8	8.1	7.8	7.7	7.9

TABLE 6 - continued

FATHEAD MINNOW LARVAE - ENVIRONMENTAL MONITORING
Santa Clara Valley NPS Sample #3838

Conductivity (umhos/cm)

Sample	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
Control	275	250	285	310	300	270	285
S-1	700	7000	700	600	600	700	700
S-2	1100	1075	1110	1100	1100	1100	1150
S-3	780	780	790	810	740	800	840
S-4	1500	1580	1500	1550	1460	1560	1580

Temperature (°C)

Sample	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
Control	25.0	25.5	25.0	26.0	23.0	25.5	26.0
S-1	25.0	25.5	25.0	26.0	24.0	25.0	26.0
S-2	25.0	25.5	25.0	26.0	24.0	25.5	26.0
S-3	25.0	25.5	25.0	26.0	23.5	24.5	26.0
S-4	25.0	25.5	24.0	26.0	25.0	25.0	24.0

Alkalinity/Hardness (as mg/l CaCO3)

Sample	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
Control	60/100	65/100	67/100	67/100	65/100	67/102	65/102
S-1	125/215	115/218	204/218	142/184	190/190	195/210	212/208
S-2	275/475	300/485	359/550	366/590	352/625	352/584	420/580
S-3	200/320	210/320	275/330	252/344	350/304	275/336	330/294
S-4	390/425	390/435	505/450	512/432	482/440	525/460	550/440

TABLE 7

SELENASTRUM CAPRICORNUTUM
GROWTH AND ENVIRONMENTAL MONITORING DATA
Santa Clara Valley NPS Sample #3838

	Cells/ml X 10^6 after 96 hours			
Sample	Replicate 1	Replicate 2	Replicate 3	Mean
Control	3.10	3.02	3.11	3.08
S-1	3.13	3.47	3.10	3.23
S-2	3.82	3.62	3.76	3.73
S-3	3.03	2.96	3.97	2.99
S-4	1.49	1.34	1.44	1.42

Bartlett's B (calculated) = 5.86
Tabled X^2 value (p=0.01, df=4) = 13.28

ANOVA F (calculated) = 181.6
ANOVA F (tabled) = 3.48

Temperature (°C)

Sample	Day 1	Day 2	Day 3	Day 4
Control	26.2	25.3	24.8	25.4
S-1	26.2	25.3	24.8	25.4
S-2	26.2	25.3	24.8	25.4
S-3	26.2	25.3	24.8	25.4
S-4	26.2	25.3	24.8	25.4

Initial pH Value and Conductivity

Sample	pH value	Conductivity (umhos/cm)
Control	8.0	275
S-1	8.2	700
S-2	8.2	1100
S-3	8.1	780
S-4	8.0	1500

APPENDIX A

Summary of Test Conditions

TABLE A-1

Ceriodaphnia Bioassay

Test Type:	Static Daily Renewal
Test Endpoints:	Survival, Reproduction
Test Duration:	7 days - 168 hours
Temperature:	25 ± 1°C
Photoperiod:	16 L: 8 D
Start:	9 April, 1989, 11:00 hours
Finish:	16 April, 1989, 11:00 hours
Test Containers:	1 oz plastic cups
Test Volume:	15 ml
Dilution Water:	Not Applicable
Test Material:	Santa Clara Valley NPS - Dry Weather #3
Test Concentrations:	100%, controls
# Replicates:	10
Organisms per replicate:	1
Test Species:	*Ceriodaphnia dubia*
Source:	in-house culture
Age:	4-8 hours
Acclimation/Culture Water:	EPA Moderately Hard (Milli-Q)
Diet:	Selenastrum, *Ceriodaphnia* chow

TABLE A-2

Fathead Minnow Bioassay

Test Type:	Static Daily Renewal
Test Endpoints:	Survival, Growth
Test Duration:	7 days - 168 hours
Temperature:	25 ± 1°C
Photoperiod:	16 L: 8 D
Start:	9 April, 1989, 12:00 hours
Finish:	16 April, 1989, 12:00 hours
Test Containers:	1 liter glass jars
Test Volume:	500 ml
Dilution Water:	Not Applicable
Test Material:	Santa Clara Valley NPS - Dry Weather #3
Test Concentrations:	100%, control
# Replicates:	3
Organisms per replicate:	10
Test Species:	*Pimephales promelas* (Fathead minnow)
Source:	in-house culture
Age:	<24 hours
Culture Water:	Dechlorinated Tap
Diet:	*Artemia* nauplii

TABLE A-3

Selenastrum Bioassay

Test Type:	Static
Test Endpoints:	Growth, (cell number)
Test Duration:	4 days, 96 hours
Temperature:	24 ± 2°C
Photoperiod:	Continuous light
Light Intensity:	400 ± 40 FC
Start:	8 April, 1989, 13:00 hours
Finish:	12 April, 1989, 13:00 hours
Test Containers:	250 ml Erlenmeyer flasks
Test Volume:	100 ml
Dilution Water:	Not Applicable
Test Material:	Santa Clara Valley NPS - Dry Weather #3
Test Concentrations:	100%, Control
# Replicates:	3
Organisms per replicate:	10,000/ml innoculated
Test Species:	*Selenastrum capricornutum*
Source:	In-house culture
Age:	4 days
Culture Water:	EPA Moderately Hard

APPENDIX F

USGS/SCVWD WATER AND SEDIMENT QUALITY DATA

USGS STATION NO. 11168800
LOS GATOS CREEK AT
LINCOLN AVENUE AT SAN JOSE, CA

11168800 - LOS GATOS C AT LINCOLN AVE AT SAN JOSE CALIF

DATE	Flow (cfs)	Cond (µmohs)	pH	Temp (deg C)	TDS (mg/l)	Turbidity (NTU)	DO (mg/l)	DO (% sat)	Organic C (mg/l as C)	TH (mg/l as CaCO3)	Alkalinity (mg/l as CaCO3)
01/12/1980	110.0	315.0	7.1	14.0	190.0	34.0	9.8		6.7	130.0	94.0
01/29/1981	39.0	256.0	7.5	11.5	150.0	44.0	10.4	96	6.9	99.0	78.0
01/05/1982	41.0	204.0	7.8	11.0	120.0	180.0	10.5	95	6.2	87.0	74.0
01/21/1982	1.7	225.0	7.9	7.5	120.0	8.8	11.3	95	4.3	81.0	72.0
01/19/1893	9.7	245.0	8.2	9.5	140.0	5.7	11.3	99	4.0	100.0	84.0
01/27/1983	400.0	188.0	7.8	11.5	120.0	440.0	10.6	99	5.6	80.0	72.0
02/20/1980	202.0	192.0	7.0	12.0	120.0	580.0	10.4		6.2	79.0	67.0
02/17/1982	9.4	321.0	8.6	14.0	190.0	9.2	10.7	103	5.5	140.0	110.0
02/08/1983	561.0	236.0	8.0	11.0	140.0	130.0	11.2	102	4.2	100.0	90.0
02/28/1984	5.0	359.0	9.1	14.0	200.0	1.9	12.6	123	2.5	150.0	124.0
02/13/1986	45.0	420.0	8.2	12.0	260.0	19.0	10.5	97		190.0	137.0
02/24/1986	59.0	160.0	8.1	13.0	120.0	500.0	10.7	101		85.0	69.0
03/06/1980	32.0	272.0	7.8	12.5	160.0	99.0	10.3		6.9	110.0	89.0
03/30/1982	251.0	296.0	8.2	11.0	180.0	32.0	11.2	102	3.4	130.0	108.0
03/01/1983	2600.0	217.0	8.0	12.0	140.0	460.0	11.0		4.5	96.0	84.0
03/17/1984	3.4	307.0	8.6	14.0	180.0	3.0	12.1	116	4.1	140.0	113.0
03/10/1985	128.0	86.0	8.2	14.0	49.0	55.0	10.0	97		31.0	25.0
03/11/1986	551.0	228.0	8.2	14.0	140.0	130.0	10.7	104		97.0	83.0
04/12/1983	18.0	317.0	9.6	14.5	180.0	2.2	16.6	163	2.3	130.0	110.0
05/06/1980	1.0	323.0	8.2	15.0	190.0	1.3	10.1	100	4.2	110.0	73.0
05/17/1983	52.0	275.0	8.8	16.5	170.0	8.7	12.5	128	1.8	130.0	110.0
08/30/1983	1.6	286.0	8.5	23.0	180.0	0.8	11.4	133	2.0	130.0	110.0
09/08/1982	1.0	295.0	7.6	23.5	180.0	1.5	8.3	98	3.0	130.0	104.0
11/20/1979	0.7	407.0	8.2	11.5	240.0	6.6	11.1		6.5	150.0	110.0
11/17/1981	2.2	259.0	7.8	15.5	150.0	2.2	9.0	89	14.0	73.0	58.0
12/30/1981	3.9	408.0	8.4	14.5	240.0	1.0	11.2	110	3.5	120.0	86.0

11168800 - LOS GATOS C AT LINCOLN AVE AT SAN JOSE CALIF

Period	Flow (cfs)	Cond (µmohs)	pH	Temp (deg C)	TDS (mg/l)	Turbidity (NTU)	DO (mg/l)	DO (% sat)	Organic C (mg/l as C)	TH (mg/l as CaCO3)	Alkalinity (mg/l as CaCO3)
All											
Mean	197.3	273.0	8.1	13.6	163.4	106.0	11.0	107	4.9	111.5	89.8
CV	2.62	0.29	0.07	0.26	0.28	1.67	0.13	0.16	0.53	0.29	0.26
n	26	26	26	26	26	26	26	21	22	26	26
Month											
Nov	1.5	333.0	8.0	13.5	195.0	4.4	10.1	89	10.3	111.5	84.0
Jan	86.5	263.0	7.8	11.4	154.3	101.9	10.7	99	5.3	99.6	80.0
Feb	146.9	281.3	8.2	12.7	171.7	206.7	11.0	105	4.6	124.0	99.5
March	511.9	246.1	8.4	13.1	147.0	111.6	11.7	116	4.2	104.9	87.4
May	26.5	299.0	8.5	15.8	180.0	5.0	11.3	114	3.0	120.0	91.5
Sept	1.3	290.5	8.1	23.3	180.0	1.2	9.9	116	2.5	130.0	107.0
Winter											
Nov-April	230.6	269.0	8.1	12.5	160.4	124.7	11.1	105.4	5.4	109.0	88.0
n	22	22	22	22	22	22	22	17	18	22	22
Summer											
May-Sept	13.9	294.8	8.3	19.5	180.0	3.1	10.6	114.8	2.8	125.0	99.3
n	4	4	4	4	4	4	4	4	4	4	4

C V = Coefficent of Variation
n = Sample number

11168800 - LOS GATOS C AT LINCOLN AVE AT SAN JOSE CALIF

DATE	Flow (cfs)	Total Phosphorous (mg/l as P)	Dis. Ortho P (mg/l as P)	Boron (mg/l as B)	Iron (mg/l as Fe)	Nitrogen NO2+NO3 (mg/l as N)	Dis. Ammonia (mg/l as N)	Total Organic N (mg/l as N)	Total ORG+NH3 (mg/l as N)	Total Nitrogen (mg/l as N)
01/12/1980	110.0	0.14	0.08	70.0	40.00	0.85	0.07	1.20	1.30	2.20
01/29/1981	39.0	0.12	0.06	40.0	40.00	0.81	0.10			
01/05/1982	41.0	0.16	0.09	40.0	59.00	1.20	0.11	0.65	0.78	2.00
01/21/1982	1.7	0.08	0.06	60.0	52.00	0.60	0.13	0.55	0.73	1.30
01/19/1893	9.7	0.05	0.01	50.0	30.00	0.33	0.06		1.10	1.40
01/27/1983	400.0	0.75	0.08	40.0	150.00	0.67	0.06	1.10	1.30	2.00
02/20/1980	202.0	0.50	0.06	50.0	160.00	1.10	0.04	1.50	1.70	2.80
02/17/1982	9.4	0.04	0.02	60.0	75.00	0.65	0.09	0.58	0.67	1.30
02/08/1983	561.0	0.16	0.07	40.0	19.00	0.32	0.10	0.92	1.00	1.30
02/28/1984	5.0	0.01	0.01	70.0	33.00	0.10	0.04	0.35	0.40	
02/13/1986	45.0	0.12	0.07	80.0	49.00		0.12	0.59	0.70	1.60
02/24/1986	59.0	0.24	0.02	30.0	84.00		0.05	1.10	1.20	2.00
03/06/1980	32.0	0.12	0.04	60.0	20.00	0.51	0.01	0.70	0.77	1.30
03/30/1982	251.0	0.02	0.03	60.0	10.00	0.40	0.12	0.42	0.52	0.92
03/01/1983	2600.0	0.66	0.03	40.0	130.00	0.30	0.12	1.70	1.80	2.10
03/17/1984	3.4	0.04	0.04	50.0	14.00	0.14	0.02	0.26	0.30	0.50
03/10/1985	128.0	0.38	0.18	20.0	44.00	0.34	0.15	1.40	1.60	1.90
03/11/1986	551.0	0.23	0.02	50.0	96.00		0.02	0.43	0.50	1.20
04/12/1983	18.0	0.03	0.02	70.0	17.00	0.10	0.06	0.61	0.70	
05/06/1980	1.0	0.01	0.00	160.0	10.00	0.02	0.03	0.83	0.93	0.97
05/17/1983	52.0	0.04	0.01	50.0	16.00	0.10	0.07	0.19	0.30	
08/30/1983	1.6	0.01	0.01	50.0	7.00	0.10	0.03		0.20	
09/08/1982	1.0	0.03	0.01	70.0	10.00	0.13	0.14	0.78	1.00	1.10
11/20/1979	0.7	0.02	0.02	110.0	10.00	0.33	0.07	0.34	0.43	0.76
11/17/1981	2.2	0.08	0.08	60.0	49.00	0.46	0.15	0.46	0.57	1.00
12/30/1981	3.9	0.07	0.05	130.0	10.00	0.98	0.07	0.54	0.66	1.70

11168800 - LOS GATOS C AT LINCOLN AVE AT SAN JOSE CALIF

Period	Flow (cfs)	Total Phosphorous (mg/l as P)	Dis. Ortho P (mg/l as P)	Boron (mg/l as B)	Iron (mg/l as Fe)	Nitrogen NO2+NO3 (mg/l as N)	Dis. Ammonia (mg/l as N)	Total Organic N (mg/l as N)	Total ORG+NH3 (mg/l as N)	Total Nitrogen (mg/l as N)
All										
Mean	197.3	0.16	0.05	61.9	47.46	0.46	0.08	0.75	0.85	1.49
CV	2.62	1.26	0.86	0.49	0.93	0.75	0.54	0.55	0.52	0.38
n	26	26	26	26	26	23	26	23	25	21
Month										
Nov	1.5	0.05	0.05	85.0	29.50	0.40	0.11	0.40	0.50	0.88
Jan	86.5	0.20	0.06	61.4	54.43	0.78	0.09	0.81	0.98	1.77
Feb	146.9	0.18	0.04	55.0	70.00	0.54	0.07	0.84	0.95	1.80
March	511.9	0.21	0.05	50.0	47.29	0.30	0.07	0.79	0.88	1.32
May	26.5	0.03	0.01	105.0	13.00	0.06	0.05	0.51	0.62	0.97
Sept	1.3	0.02	0.01	60.0	8.50	0.12	0.09	0.78	0.60	1.10
Winter										
Nov-April	230.6	0.18	0.05	58.2	54.1	0.54	0.08	0.77	0.89	1.54
n	22	22	22	22	22	19	22	20	21	19
Summer										
May-Sept	13.9	0.02	0.01	82.5	10.8	0.09	0.07	0.60	0.61	1.04
n	4	4	4	4	4	4	4	3	4	2

C V = Coefficent of Variation
n = Sample number

Station # 11168800 - LOS GATOS CREEK AT LINCOLN AVE. AT SAN JOSE CALIF

DATE	Flow (cfs)	Zn Dissolved (µg/l)	Zn Sediment (µg/gm)	Pb Dissolved (µg/l)	Pb Sediment (µg/gm)	Cu Dissolved (µg/l)	Cu Sediment (µg/gm)	As Dissolved (µg/l)	As Sediment (µg/gm)
01/05/1982	41	10	80	6	60	2	20	1	5
01/27/1983	400	4	60	1	50	3	10	1	4
02/20/1980	202	20	100	6	150	2	30	1	5
02/13/1986	45	18		2		2		1	
02/24/1986	59	10		1		1		1	
08/30/1983	1.6	6	30	1	20	2	10	1	3
09/08/1982	1	10	30	1	20	2	9	1	15
All									
Mean	107.1	11.1	60.0	2.6	60.0	2.0	15.8	1.0	6.4
CV	1.36	0.53	0.51	0.92	0.89	0.29	0.58	0.00	0.76
n	7	7	5	7	5	7	5	7	5
Winter									
Mean	149.4	12.4	80.0	3.2	86.7	2.0	20.0	1.0	4.7
n	5	5	3	5	3	5	3	5	3
Summer									
Mean	1.3	8.0	30.0	1.0	20.0	2.0	9.5	1.0	9.0
n	2	2	2	2	2	2	2	2	2

Station # 11168800 - LOS GATOS CREEK AT LINCOLN AVE. AT SAN JOSE CALIF

DATE	Flow (cfs)	Fe Sediment (µg/l)	Mn Dissolved (µg/l)	Mn Sediment (µg/gm)	Al Dissolved (µg/l)	Al Sediment (µg/gm)	Co Sediment (µg/gm)
01/05/1982	41	13000	10	270	30	6500	10
01/27/1983	400	8500	11	200	130	5000	10
02/20/1980	202	6200	0	240	170	60	20
02/13/1986	45		6		20		
02/24/1986	59		10		30		
08/30/1983	1.6	5500	1	170	10	3200	10
09/08/1982	1	3200	10	110	10	1900	10
All							
Mean	107.1	7280.0	6.9	198.0	57.1	3332.0	12.0
CV	1.36	0.51	0.68	0.31	1.14	0.76	0.37
n	7	5	7	5	7	5	5
Winter							
Mean	149.4	9233.3	7.4	236.7	76.0	3853.3	13.3
n	5	3	5	3	5	3	3
Summer							
Mean	1.3	4350.0	5.5	140.0	10.0	2550.0	10.0
n	2	2	2	2	2	2	2

Station # 11168800 - LOS GATOS CREEK AT LINCOLN AVE. AT SAN JOSE CALIF

DATE	Flow (cfs)	Cd Dissolved (µg/l)	Cd Sediment (µg/gm)	Cr Dissolved (µg/l)	Cr Sediment (µg/gm)	Hg Dissolved (µg/l)	Hg Sediment (µg/gm)	Ni AS NI) (01065)	Se Sediment (µg/gm)
01/05/1982	41	1	1	<10	30	<0.1	0.07	<100	<1
01/27/1983	400	<1	<1	<10	20	<0.1	0.06	<100	<1
02/20/1980	202	0	1	0	20	0.1	0.03	0	0
02/13/1986	45	<1		<10		<0.1		<100	
02/24/1986	59	<1		<10		<0.1		<100	
08/30/1983	1.6	<1	<1	<10	10	<0.1	0.04	<100	<1
09/08/1982	1	<1	<1	<10	6	<0.1	0.03	<100	<1

11168800 - LOS GATOS C AT LINCOLN AVE AT SAN JOSE CALIF

DATE	Total Diazinon (µg/l)	Total 2,4-D, (µg/l)	Total Lindane (µg/l)	Total Malathion (µg/l)	Total Chlordane (µg/l)	Total DDD (µg/l)	Total DDE (µg/l)	Total DDT (µg/l)	Total Dieldrin (µg/l)	Total Heptachlor (µg/l)
02/20/1980	0.02		0.01	0	0	0	0	0.01	0	0
01/05/1982	0.03	0.02	0.01	0.13	0	0	0	0	0	0
09/08/1982	<0.01	0.02	<0.010	<0.01	<0.1	<0.010	<0.010	<0.010	<0.010	<0.010
01/27/1983	0.03	0.01	0.02	0.01	0.1	<0.010	0.01	<0.010	<0.010	<0.010
04/12/1983	0.01	0.03	<0.010	<0.01	<0.1	<0.010	<0.010	<0.010	<0.010	<0.010
08/30/1983	0.01	0.02	<0.010	<0.01	<0.1	<0.010	<0.010	<0.010	<0.010	<0.010
02/13/1986	0.1	0.03	<0.010	0.01	<0.1	<0.010	<0.010	<0.010	<0.010	<0.010

11168800 - LOS GATOS C AT LINCOLN AVE AT SAN JOSE CALIF

DATE	Naphthalenes Polychlor (µg/l)	Total PCB (µg/l)	Total Aldrin (µg/l)	Total Endosulfan (µg/l)	Total Endrin (µg/l)	Total Ethion (µg/l)	Total Chlor Epoxide (µg/l)	Total Oxychlor (µg/l)	Total Methyl Parathion (µg/l)
02/20/1980	0	0	0	0	0	0	0	0	0
01/05/1982	0	0	0	0	0	0	0	0	0
09/08/1982	<0.10	<0.1	<0.010	<0.010	<0.010	<0.01	<0.010	<0.01	<0.01
01/27/1983	<0.10	<0.1	<0.010	<0.010	<0.010	<0.01	<0.010	<0.01	<0.01
04/12/1983	<0.10	<0.1	<0.010	<0.010	<0.010	<0.01	<0.010	<0.01	<0.01
08/30/1983	<0.10	<0.1	<0.010	<0.010	<0.010	<0.01	<0.010	<0.01	<0.01
02/13/1986	<0.10	<0.1	<0.010	<0.010	<0.010	<0.01	<0.010	<0.01	<0.01

11168800 - LOS GATOS C AT LINCOLN AVE AT SAN JOSE CALIF

DATE	Total Methyl Trithion (µg/l)	Total Mirex (µg/l)	Total Perthane (µg/l)	Total Toxaphene (µg/l)	Total Trithion (µg/l)	Total 2,4,5-T (µg/l)	Total Silvex (µg/l)
02/20/1980	0	0	0	0	0		
01/05/1982	0	0	0	0	0	0	0
09/08/1982	<0.01	<0.01	<0.1	<1	<0.01	<0.01	<0.01
01/27/1983	<0.01	<0.01	<0.1	<1	<0.01	<0.01	<0.01
04/12/1983	<0.01	<0.01	<0.1	<1	<0.01	<0.01	<0.01
08/30/1983	<0.01	<0.01	<0.1	<1	<0.01	<0.01	<0.01
02/13/1986	<0.01	<0.01	<0.1	<1	<0.01	<0.01	<0.01

USGS STATION NO. 11168660
LOS GATOS CREEK AT
LARK AVENUE AT LOS GATOS, CA

11168660 - LOS GATOS C AT LARK A AT LOS GATOS CALIF

DATE	Flow (cfs)	Cond (µmohs)	pH	Temp (deg C)	TDS (mg/l)	Turbidity (NTU)	DO (mg/l)	DO (% sat)	Organic C (mg/l as C)	TH (mg/l as CaCO3)	Alkalinity (mg/l as CaCO3)
01/17/1979	34.0	339.0	7.5	10.0	200.0		8.9			150.0	110.0
01/12/1980	211.0	347.0	7.2	12.5	230.0	37.0	10.2		5.9	170.0	130.0
01/29/1981	68.0	343.0	7.2	11.0	190.0	46.0	10.5	96.0	8.2	140.0	110.0
01/05/1982	192.0	182.0	7.8	10.0	110.0	240.0	10.8	97.0	6.3	84.0	74.0
01/21/1982	16.0	366.0	7.8	8.5	210.0	24.0	10.8	93.0	4.2	170.0	143.0
01/19/1983	33.0	308.0	7.7	8.5	180.0	22.0	10.9	94.0	3.8	140.0	110.0
01/27/1983	108.0	177.0	7.7	10.5	130.0	340.0	10.4	95.0	5.6	81.0	74.0
01/15/1985	2.2	608.0	8.0	8.5	370.0	25.0	9.2	79.0	2.1	290.0	246.0
01/29/1985	2.7	588.0	7.9	9.0	350.0	20.0	9.2	80.0	3.6	270.0	236.0
01/29/1986	2.7	556.0	8.0	11.5	340.0	1.5	8.0	74.0		270.0	185.0
02/14/1979	24.0	388.0	8.4	12.5	240.0		7.6			180.0	120.0
02/19/1980	294.0	170.0	7.6	12.5	100.0	730.0	10.2		7.1	73.0	63.0
02/17/1982	43.0	303.0	8.0	13.0	170.0	56.0	10.2	96.0	5.2	140.0	112.0
02/08/1983	656.0	232.0	7.9	11.0	140.0	140.0	10.9	100.0	4.6	100.0	88.0
02/28/1984	24.0	355.0	8.5	12.0	210.0	3.2	10.6	99.0	2.9	160.0	133.0
02/08/1985	159.0	178.0	7.7	11.0	110.0	43.0	9.7	89.0		77.0	60.0
02/13/1986	47.0	443.0	8.2	11.5	270.0	20.0	9.8	90.0		210.0	153.0
02/24/1986	485.0	156.0	8.0	13.0	120.0	400.0	10.2	98.0		86.0	67.0
03/16/1979	17.0	410.0	8.3	13.5	250.0		11.5			190.0	140.0
03/27/1979	68.0	372.0	8.0	14.5	230.0		9.8			170.0	130.0
03/06/1980	369.0	271.0	7.3	12.0	160.0	110.0	10.6		11.0	120.0	89.0
03/05/1981	17.0	394.0	7.3	11.0	240.0	7.4	9.9	91.0	6.2	180.0	140.0
03/27/1981	18.0	396.0	8.1	13.0	240.0	12.0	9.6	91.0	6.5	180.0	140.0
03/30/1982	388.0	297.0	8.0	10.5	180.0	33.0	11.0	99.0	3.6	130.0	107.0
03/01/1983	1240.0	204.0	7.9	12.0	130.0	380.0	10.6	99.0	4.1	90.0	82.0
03/17/1984	29.0	346.0	8.3	13.5	210.0	8.0	9.0	86.0	5.6	160.0	129.0
03/10/1985	10.0	436.0	8.4	13.0	260.0	7.8	11.4	109.0		200.0	145.0
03/11/1986	649.0	228.0	8.2	14.0	130.0	120.0	10.1	99.0		97.0	74.0
04/12/1983	66.0	288.0	8.4	12.5	180.0	17.0	10.6	100.0	1.8	130.0	120.0
04/26/1979	21.0	387.0	8.1	15.5	230.0		9.8			170.0	120.0
05/23/1979	1.3	397.0	8.4	25.5	250.0		12.1			200.0	130.0
05/06/1980	23.0	316.0	8.2	16.5	200.0	9.0	9.9	102.0	7.2	150.0	120.0
05/19/1981	2.1	413.0	7.7	16.0	270.0	0.8	6.0	61.0	7.3	190.0	150.0
05/18/1982	31.0	293.0	8.2	15.0	190.0	8.6	9.7	97.0	2.2	140.0	118.0
05/17/1983	96.0	273.0	8.3	14.5	170.0	15.0	9.9	97.0	1.7	130.0	110.0

05/13/1986	29.0	279.0	8.3	16.0	180.0	20.0	8.9	91.0		130.0	108.0
06/12/1984	21.0	353.0	8.3	19.0	210.0	1.5	8.2	89.0	2.8	160.0	133.0
06/13/1985	43.0	506.0	8.3	21.5	310.0	6.1	8.0	92.0		240.0	169.0
07/31/1979	13.0	387.0	7.7	21.0	240.0		8.9			160.0	130.0
07/16/1980	30.0	298.0	7.4	16.5	190.0	13.0	9.2	95.0	2.7	140.0	120.0
07/14/1981	12.0	437.0	8.0	22.5	280.0	1.5	6.9	81.0	5.0	200.0	150.0
07/20/1982	32.0	289.0	8.1	20.0	180.0	4.1	8.5	94.0	2.8	140.0	116.0
07/12/1983	60.0	301.0	8.2	17.5	170.0	5.0	8.9	94.0	1.9	130.0	110.0
07/10/1984	23.0	366.0	8.3	21.5	210.0	3.9	7.7	88.0	2.8	160.0	131.0
07/24/1985	13.0	563.0	8.1	24.0	340.0	1.6	6.7	81.0		260.0	198.0
07/22/1986	27.0	299.0	8.4	20.5	180.0	2.9	8.5	95.0		130.0	117.0
08/30/1983	46.0	292.0	8.1	19.0	180.0	3.3	8.4	91.0	2.0	140.0	110.0
08/27/1984	43.0	363.0	7.7	19.5	210.0	5.0	8.3	91.0	3.3	170.0	130.0
09/04/1979	28.0	399.0	8.2	21.0	240.0		8.4			180.0	120.0
09/10/1980	74.0	318.0	7.8	19.0	200.0	4.4	8.8		4.1	150.0	120.0
09/01/1981	11.0	488.0	7.6	22.0	300.0	1.5	6.8	79.0	3.4	220.0	160.0
09/08/1982	63.0	279.0	7.8	17.5	170.0	3.0	9.2	97.0	2.5	130.0	106.0
09/11/1985	2.2	554.0	8.0	17.0	330.0	3.5	6.4	67.0		250.0	194.0
09/23/1986	5.5	365.0	8.1	18.0	210.0	1.3	7.1	76.0		160.0	144.0
11/20/1979	10.0	446.0	7.5	13.5	300.0	1.8	9.5		11.0	230.0	160.0
11/18/1980	16.0	392.0	8.3	13.0	220.0	2.5	11.0	104.0	6.2	170.0	150.0
11/17/1981	31.0	377.0	7.9	15.5	240.0	15.0	9.0	91.0	15.0	170.0	130.0
11/16/1982	53.0	341.0	8.3	13.0	210.0	3.3	9.5	91.0	2.9	150.0	130.0
12/30/1981	0.6	459.0	7.7	12.0	270.0	3.0	7.0	66.0	5.9	210.0	180.0

11168660 - LOS GATOS C AT LARK A AT LOS GATOS CALIF

Period	Flow (cfs)	Cond (µmohs)	pH	Temp (deg C)	TDS (mg/l)	Turbidity (NTU)	DO (mg/l)	DO (% sat)	Dis Organic C (mg/l as C)	TH (mg/l as CaCO3)	Alkalinity (mg/l as CaCO3)
All											
Mean	104.0	354.4	8.0	14.9	216.3	58.5	9.3	90.5	4.9	162.7	128.4
CV	2.01	0.29	0.04	0.28	0.29	2.29	0.15	0.11	0.58	0.31	0.29
n	59	59	59	59	59	51	59	46	39	59	59
Month											
Nov	27.5	389.0	8.0	13.8	242.5	5.7	9.8	95.3	8.8	180.0	142.5
Jan	60.9	388.5	7.7	10.2	234.5	75.9	9.6	86.0	5.1	179.5	145.3
Feb	216.5	278.1	8.0	12.1	170.0	198.9	9.9	95.3	5.0	128.3	99.5
March	261.0	331.1	8.0	12.7	200.9	77.2	10.4	96.8	5.5	149.7	117.8
May	29.7	357.4	8.2	17.7	223.3	8.7	9.2	89.9	4.2	167.8	128.7
July	26.3	367.5	8.0	20.4	223.8	4.6	8.2	89.7	3.0	165.0	134.0
Sept	34.1	382.3	7.9	19.1	230.0	3.1	7.9	83.5	3.1	175.0	135.5
Winter											
Nov - April	154.4	346.7	7.9	12.2	212.0	89.4	9.9	93.4	6.1	159.4	126.3
n	35	35	35	35	35	30	35	26	24	35	35
Summer											
May - Sept	30.4	369.1	8.0	19.1	225.7	5.5	8.4	87.7	3.4	169.3	132.7
n	24	24	24	24	24	21	24	20	15	24	24

C V = Coefficent of Variation
n = Sample number

flow	tds	turb	th	tp	no2+no3	tn
27.50	242.50	5.65	180.00	0.03	0.31	1.20
60.93	234.55	75.85	179.55	0.17	0.79	1.64
216.50	170.00	198.89	128.25	0.26	0.54	2.33
261.00	200.91	77.24	149.73	0.10	0.39	1.13
29.71	223.33	8.71	167.78	0.04	0.20	0.96
26.25	223.75	4.57	165.00	0.03	0.09	0.81
34.09	230.00	3.14	175.00	0.04	0.10	0.89

11168660 - LOS GATOS C AT LARK A AT LOS GATOS CALIF

DATE	Flow (cfs)	Total Phosphorous (mg/l as P)	Dis. Ortho P (mg/l as P)	Boron (mg/l as B)	Iron (mg/l as Fe)	Nitrogen NO2+NO3 (mg/l as N)	Dis. Ammonia (mg/l as N)	Total Organic N (mg/l as N)	Total ORG+NH3 (mg/l as N)	Total Nitrogen (mg/l as N)
01/17/1979	34.0	0.12	0.01	60.0	30.00	0.83	0.06	0.58	0.66	1.50
01/12/1980	211.0	0.12	0.04	60.0	50.00	0.77	0.14	1.20	1.30	2.10
01/29/1981	68.0	0.11	0.04	40.0	60.00	0.84	0.10	1.20	1.30	2.20
01/05/1982	192.0	0.18	0.10	40.0	85.00	1.10	0.10	0.84	0.96	2.10
01/21/1982	16.0	0.07	0.06	50.0	52.00	1.30	0.15	0.62	0.76	2.10
01/19/1983	33.0	0.08	0.01	50.0	15.00	0.29	0.06		0.40	0.70
01/27/1983	108.0	0.75	0.07	30.0	170.00	0.67	0.13	1.00	1.20	1.80
01/15/1985	2.2	0.13	0.04	80.0	6.00	0.72	0.44	0.47	0.90	1.60
01/29/1985	2.7	0.09	0.02	80.0	5.00	0.41	0.21	0.48	0.70	1.10
01/29/1986	2.7	0.05	0.02	80.0	5.00		0.12	0.57	0.70	1.20
02/14/1979	24.0	0.06	0.01	90.0	20.00	0.45	0.02	0.42	0.50	0.92
02/19/1980	294.0	0.63	0.08	50.0	160.00	1.00	0.06	2.70	3.00	4.10
02/17/1982	43.0	0.07	0.04	50.0	74.00	0.72	0.09	0.64	0.74	1.50
02/08/1983	656.0	0.15	0.07	40.0	16.00	0.32	0.12	1.10	1.20	1.50
02/28/1984	24.0	0.04	0.01	50.0	33.00	0.10	0.03	0.25	0.30	
02/08/1985	159.0	0.80	0.02	30.0	500.00	0.63	0.33	4.10	4.50	5.10
02/13/1986	47.0	0.07	0.06	90.0	32.00		0.15	0.56	0.70	1.40
02/24/1986	485.0	0.23	0.02	30.0	16.00		0.05	1.00	1.10	1.80
03/16/1979	17.0	0.03	0.01	80.0	30.00	0.54	0.04	0.39	0.46	1.00
03/27/1979	68.0	0.04	0.01	80.0	20.00	0.51	0.12	0.48	0.57	1.10
03/06/1980	369.0	0.11	0.03	50.0	70.00	0.44	0.01	1.20	1.20	1.70
03/05/1981	17.0	0.07	0.00	50.0	20.00	0.54	0.05	0.81	0.86	1.40
03/27/1981	18.0	0.05	0.00	40.0	10.00	0.32	0.04	0.64	0.67	0.99
03/30/1982	388.0	0.07	0.04	50.0	14.00	0.40	0.11	0.33	0.48	0.88
03/01/1983	1240.0	0.44	0.03	40.0	86.00	0.31	0.08	1.30	1.40	1.70
03/17/1984	29.0	0.05	0.02	50.0	9.00	0.18	0.05	0.67	0.70	0.90
03/10/1985	10.0	0.05	0.01	70.0	18.00	0.33	0.01	0.45	0.50	0.80
03/11/1986	649.0	0.12	0.02	40.0	110.00		0.04	0.33	0.40	1.00
04/12/1983	66.0	0.05	0.03	40.0	13.00	0.30	0.06	0.58	0.70	1.00
04/26/1979	21.0	0.03	0.02	90.0	20.00	0.38	0.01	0.35	0.43	0.83
05/23/1979	1.3	0.03	0.01	80.0	10.00	0.27	0.01	0.36	0.41	0.83
05/06/1980	23.0	0.03	0.00	50.0	10.00	0.20	0.06	1.40	1.50	1.70
05/19/1981	2.1	0.05	0.03	40.0	10.00	0.26	0.16	0.49	0.66	0.93
05/18/1982	31.0	0.07	0.01	40.0	9.00	0.16	0.11	0.47	0.57	0.73
05/17/1983	96.0	0.04	0.01	40.0	15.00	0.14	0.07	0.80	0.90	1.00

05/13/1986	29.0	0.06	0.01	40.0	4.00		0.05	0.45	0.50	0.70
06/12/1984	21.0	0.01	0.01	50.0	9.00	0.10	0.03	0.36	0.40	
06/13/1985	43.0	0.05	0.01	70.0	3.00	0.10	0.05	0.32	0.40	
07/31/1979	13.0	0.01	0.01	90.0	10.00	0.03	0.04	0.34	0.36	0.41
07/16/1980	30.0	0.06	0.00	70.0	10.00	0.25	0.04	0.75	0.83	1.10
07/14/1981	12.0	0.05	0.02	60.0	10.00	0.04	0.11	0.48	0.73	0.82
07/20/1982	32.0	0.01	0.01	50.0	8.00	0.10	0.11	0.98	1.10	1.20
07/12/1983	60.0	0.04	0.01	40.0	11.00	0.10	0.06	0.46	0.50	
07/10/1984	23.0	0.01	0.01	50.0	3.00	0.10	0.01	0.26	0.30	
07/24/1985	13.0	0.04	0.04	70.0	10.00	0.01	0.06	0.35	0.40	
07/22/1986	27.0	0.01	0.01	50.0	11.00		0.04	0.26	0.30	0.50
08/30/1983	46.0	0.01	0.01	40.0	10.00	0.10	0.03	0.20	0.30	
08/27/1984	43.0	0.02	0.01	50.0	4.00	0.10	0.03	0.27	0.30	
09/04/1979	28.0	0.04		70.0	10.00		0.11	0.61	0.70	0.79
09/10/1980	74.0	0.04	0.04	70.0	10.00	0.08	0.04	0.54	0.56	0.66
09/01/1981	11.0	0.07	0.02	80.0	10.00	0.08	0.15	0.79	0.98	1.00
09/08/1982	63.0	0.04	0.01	50.0	3.00	0.15	0.10	0.68	0.90	1.10
09/11/1985	2.2	0.08	0.03	90.0	8.00	0.11	0.08	0.71	0.80	0.90
09/23/1986	5.5	0.05	0.01	60.0	5.00		0.05	0.32	0.40	
11/20/1979	10.0	0.02	0.02	80.0	10.00	0.18	0.12	0.45	0.61	0.79
11/18/1980	16.0	0.02	0.01	80.0	10.00	0.07	0.05			
11/17/1981	31.0	0.06	0.06	50.0	40.00	0.88	0.26	0.52	0.75	1.60
11/16/1982	53.0	0.01	0.01	50.0	5.00	0.10	0.08		1.20	
12/30/1981	0.6	0.12	0.09	60.0	26.00	0.99	0.11	0.52	0.66	1.60

11168660 - LOS GATOS C AT LARK A AT LOS GATOS CALIF

Period	Flow (cfs)	Total Phosphorous (mg/l as P)	Dis Ortho P (mg/l as P)	Boron (mg/l as B)	Iron (mg/l as Fe)	Nitrogen NO2+NO3 (mg/l as N)	Dis. Ammonia (mg/l as N)	Total Organic N (mg/l as N)	Total ORG+NH3 (mg/l as N)	Total Nitrogen (mg/l as N)
All										
Mean	104.0	0.10	0.03	57.6	34.63	0.37	0.09	0.70	0.82	1.34
CV	2.01	1.58	0.92	0.31	2.05	0.86	0.86	0.87	0.80	0.62
	59	59	58	59	59	51	59	56	58	48
Month										
Nov	27.5	0.03	0.03	65.0	16.25	0.31	0.13	0.49	0.85	1.20
Jan	60.9	0.17	0.05	57.3	45.82	0.79	0.15	0.75	0.87	1.64
Feb	216.5	0.26	0.04	53.8	106.38	0.54	0.11	1.35	1.51	2.33
March	261.0	0.10	0.02	53.6	36.36	0.39	0.06	0.65	0.72	1.13
May	29.7	0.04	0.01	55.6	10.00	0.20	0.06	0.56	0.64	0.96
July	26.3	0.03	0.01	60.0	9.13	0.09	0.06	0.49	0.57	0.81
Sept	34.1	0.04	0.02	63.8	7.50	0.10	0.07	0.52	0.62	0.89
Winter										
Nov - April	141.5	0.14	0.03	57.4	51.20	0.51	0.11	0.81	0.99	1.57
n	35	35	35	35	35	31	35	32	34	32
Summer										
May - Sept	30.0	0.04	0.01	59.8	8.88	0.13	0.06	0.52	0.61	0.89
n	24	24	23	24	24	20	24	24	24	16

C V = Coefficent of Variation
n = Sample number

Station # 11168660 - LOS GATOS CREEK AT LARK AVE. AT LOS GATOS CALIF

DATE	Flow (cfs)	Zn Dissolved (µg/l)	Zn Sediment (µg/gm)	Pb Dissolved (µg/l)	Pb Sediment (µg/gm)	Cu Dissolved (µg/l)	Cu Sediment (µg/gm)	As Dissolved (µg/l)	As Sediment (µg/gm)
01/17/1979	34	3		7		3		1	
01/05/1982	192	10	60	6	30	2	20	1	7
01/27/1983	108	7	60	1	20	2	20	1	4
02/19/1980	294	10	60	ND	90	1	20	1	5
02/08/1985	159	16	70	2	40	2	30	1	7
02/13/1986	47	51		3		1		1	
02/24/1986	485	10		1		2		1	
03/27/1981	18	10	40	ND	40	4	8	2	9
07/31/1979	13	3		ND		ND		1	
08/30/1983	46	6	30	1	10	1	20	1	3
08/27/1984	43	17	80	1	20	1	30	1	1
09/10/1980	74	10	50	4	40		20	2	4
09/01/1981	11	10	60	2	10	9	20	2	4
09/08/1982	63	10	50	1	20	1	20	1	4
09/11/1985	2.2	10	120	1	60	4	50	2	6
All									
Mean	105.9	12.2	61.8	2.5	34.5	2.5	23.5	1.3	4.9
CV	1.25	0.93	0.38	0.84	0.69	0.88	0.45	0.36	0.45
n	15	15	11	12	11	13	11	15	11
Winter									
Mean	167.1	14.6	58.0	3.3	44.0	2.1	19.6	1.1	6.4
CV	0.95	1.04	0.19	0.77	0.61	0.47	0.40	0.31	0.30
n	8	8	5	6	5	8	5	8	5
Summer									
Mean	36.0	9.4	65.0	1.7	26.7	3.2	26.7	1.4	3.7
CV	0.77	0.46	0.48	0.73	0.74	1.09	0.45	0.37	0.45
n	7	7	6	6	6	5	6	7	6

Station # 11168660 - LOS GATOS CREEK AT LARK AVE. AT LOS GATOS CALIF

DATE	Flow (cfs)	Fe Sediment (µg/l)	Mn Dissolved (µg/l)	Mn Sediment (µg/gm)	Al Dissolved (µg/l)	Al Sediment (µg/gm)	Co Sediment (µg/gm)
01/17/1979	34		10		10		
01/05/1982	192	14000	10	460	40	7500	10
01/27/1983	108	10000	30	410	150	6000	10
02/19/1980	294	7300	ND	190	50	640	10
02/08/1985	159	36000	400	780	50	16000	30
02/13/1986	47		41		10		
02/24/1986	485		10		40		
03/27/1981	18	7000	50	480	10	4200	10
07/31/1979	13		100		100		
08/30/1983	46	4800	24	300	10	2300	10
08/27/1984	43	18000	75	860	10	9300	10
09/10/1980	74	10000	130	350	ND	3400	20
09/01/1981	11	16000	10	600	ND	4000	10
09/08/1982	63	8000	20	310	10	3300	10
09/11/1985	2.2	22000	130	2100	10	13000	20
All							
Mean	105.9	13918.2	74.3	621.8	38.5	6330.9	13.6
CV	1.25	0.65	1.39	0.85	1.12	0.75	0.49
n	15	11	14	11	13	11	11
Winter							
Mean	167.1	14860.0	78.7	464.0	45.0	6868.0	14.0
CV	0.95	0.82	1.81	0.45	1.02	0.83	0.64
n	8	5	7	5	8	5	5
Summer							
Mean	36.0	13133.3	69.9	753.3	28.0	5883.3	13.3
CV	0.77	0.50	0.75	0.92	1.44	0.73	0.39
n	7	6	7	6	5	6	6

Station # 11168660 - LOS GATOS CREEK AT LARK AVE. AT LOS GATOS CALIF

DATE	Flow (cfs)	Cd Dissolved (µg/l)	Cd Sediment (µg/gm)	Cr Dissolved (µg/l)	Cr Sediment (µg/gm)	Hg Dissolved (µg/l)	Hg Sediment (µg/gm)	Ni Dissolved (µg/l)	Se Dissolved (µg/l)	Se Sediment (µg/gm)
01/17/1979	34	<2		<20		<0.1		ND		
01/05/1982	192	1	1	<10	30	<0.1	0.08	<100		<1
01/27/1983	108	<1	<1	<10	20	<0.1	0.05	<100		<1
02/19/1980	294	0	0	0	20	0	0.03	0		0
02/08/1985	159	<1	<1	<10	160	<0.1	1.5	<100	<1	<1
02/13/1986	47	<1		<10		<0.1		<100		
02/24/1986	485	<1		<10		<0.1		<100		
03/27/1981	18	0	0	10	14	0	0.9	0		0
07/31/1979	13	2		<20		<0.1		ND		
08/30/1983	46	<1	<1	<10	9	<0.1	0.06	<100		<1
08/27/1984	43	<1	<1	<10	40	<0.1	1.1	<100		<1
09/10/1980	74	0	2	0	21	0	0.04	0		0
09/01/1981	11	1	<1	0	30	0	0.06	0		0
09/08/1982	63	<1	<1	<10	20	<0.1	0.05	<100		<1
09/11/1985	2.2	1	0		680	<0.1	0.2	<100		<1

Station #11168660 - LOS GATOS CREEK AT LARK AVE. AT LOS GATOS CALIF

DATE	Total Diazinon (μg/l)	Total 2,4-D, (μg/l)	Total Lindane (μg/l)	Total Malathion (μg/l)	Total Chlordane (μg/l)	Total DDD (μg/l)	Total DDE (μg/l)	Total DDT (μg/l)	Total Dieldrin (μg/l)	Total Heptachlor (μg/l)
02/19/1980	0.01	0.02	0.01	0	0	0	0.01	0.02	0	0
09/10/1980	0	0	0	0	0	0	0	0	0	0
03/27/1981	0.01	0	0	0	0	0	0	0	0	0
09/01/1981	0	0.01	0	0.61	0	0	0	0	0	0
01/05/1982	0.01	0.02	0	0.1	0	0	0	0	0	0
09/08/1982	<0.01	<0.01	<0.010	<0.01	<0.1	<0.010	<0.010	<0.010	<0.010	<0.010
01/27/1983	0.02		0.01	0.01	<0.1	<0.010	<0.010	<0.010	<0.010	<0.010
04/12/1983	<0.01	<0.01	<0.010	<0.01	<0.1	<0.010	<0.010	<0.010	<0.010	<0.010
08/30/1983	<0.01	<0.01	<0.010	<0.01	<0.1	<0.010	<0.010	<0.010	<0.010	<0.010
08/27/1984	<0.01	0.01	<0.010	<0.01	<0.1	<0.010	<0.010	<0.010	<0.010	<0.010
02/08/1985	0.16	0.04	0.01	0.01	0.1	0.01	0.01	0.01	<0.010	<0.010
09/11/1985	<0.01	<0.01	<0.010	<0.01	<0.1	<0.010	<0.010	<0.010	<0.010	<0.010
01/29/1986	0.06	0.01	<0.010	<0.01	<0.1	<0.010	<0.010	<0.010	<0.010	<0.010
02/13/1986	0.1	0.01	<0.010	<0.01	<0.1	<0.010	<0.010	<0.010	<0.010	<0.010
02/24/1986	<0.01		<0.010	<0.01	<0.1	<0.010	<0.010	<0.010	<0.010	<0.010
07/22/1986	<0.01	<0.01	<0.010	<0.01	<0.1	<0.010	<0.010	<0.010	<0.010	<0.010
07/23/1986	<0.01	0.01	<0.010	<0.01	<0.1	<0.010	<0.010	<0.010	<0.010	<0.010

Station #11168660 - LOS GATOS CREEK AT LARK AVE. AT LOS GATOS CALIF

DATE	Naphthalenes Polychlor (µg/l)	Total PCB (µg/l)	Total Aldrin (µg/l)	Total Endosulfan (µg/l)	Total Endrin (µg/l)	Total Ethion (µg/l)	Total Chlor Epoxide (µg/l)	Total Oxychlor (µg/l)	Total Methyl Parathion (µg/l)
02/19/1980	0	0	0	0	0	0	0	0	0
09/10/1980	0	0	0	0	0	0	0	0	0
03/27/1981	0	0	0	0	0	0	0	0	0
09/01/1981	0	0	0	0	0	0	0	0	0
01/05/1982	0	0	0	0	0	0	0	0	0
09/08/1982	<0.10	<0.1	<0.010	<0.010	<0.010	<0.01	<0.010	<0.01	<0.01
01/27/1983	<0.10	<0.1	<0.010	<0.010	<0.010	<0.01	<0.010	<0.01	<0.01
04/12/1983	<0.10	<0.1	<0.010	<0.010	<0.010	<0.01	<0.010	<0.01	<0.01
08/30/1983	<0.10	<0.1	<0.010	<0.010	<0.010	<0.01	<0.010	<0.01	<0.01
08/27/1984	<0.10	<0.1	<0.010	<0.010	<0.010	<0.01	<0.010	<0.01	<0.01
02/08/1985	<0.10	<0.1	<0.010	<0.010	<0.010	<0.01	<0.010	<0.01	<0.01
09/11/1985	<0.10	<0.1	<0.010	<0.010	<0.010	<0.01	<0.010	<0.01	<0.01
01/29/1986	<0.10	<0.1	<0.010	<0.010	<0.010	<0.01	<0.010	<0.01	<0.01
02/13/1986	<0.10	<0.1	<0.010	<0.010	<0.010	<0.01	<0.010	<0.01	<0.01
02/24/1986	<0.10	<0.1	<0.010	<0.010	<0.010	<0.01	<0.010	<0.01	<0.01
07/22/1986	<0.10	<0.1	<0.010	<0.010	<0.010	<0.01	<0.010	<0.01	<0.01
07/23/1986	<0.10	<0.1	<0.010	<0.010	<0.010	<0.01	<0.010	<0.01	<0.01

Station #11168660 - LOS GATOS CREEK AT LARK AVE. AT LOS GATOS CALIF

DATE	Total Methyl Trithion (µg/l)	Total Mirex (µg/l)	Total Perthane (µg/l)	Total Toxaphene (µg/l)	Total Trithion (µg/l)	Total 2,4,5-T (µg/l)	Total Silvex (µg/l)
02/19/1980	0	0	0	0	0	0	0.01
09/10/1980	0	0	0	0	0	0	0
03/27/1981	0	0	0	0	0	0	0
09/01/1981	0	0	0	0	0	0	0
01/05/1982	0	0	0	0	0	0	0.01
09/08/1982	<0.01	<0.01	<0.1	<1	<0.01	<0.01	<0.01
01/27/1983	<0.01	<0.01	<0.1	<1	<0.01		
04/12/1983	<0.01	<0.01	<0.1	<1	<0.01	<0.01	<0.01
08/30/1983	<0.01	<0.01	<0.1	<1	<0.01	<0.01	<0.01
08/27/1984	<0.01	<0.01	<0.1	<1	<0.01	<0.01	<0.01
02/08/1985	<0.01	<0.01	<0.1	<1	<0.01	<0.01	<0.01
09/11/1985	<0.01	<0.01	<0.1	<1	<0.01	<0.01	<0.01
01/29/1986	<0.01	<0.01	<0.1	<1	<0.01	<0.01	<0.01
02/13/1986	<0.01	<0.01	<0.1	<1	<0.01	<0.01	<0.01
02/24/1986	<0.01	<0.01	<0.1	<1	<0.01		
07/22/1986	<0.01	<0.01	<0.1	<1	<0.01	<0.01	<0.01
07/23/1986	<0.01	<0.01	<0.1	<1	<0.01	<0.01	<0.01

8720115A-F CON-4

USGS STATION NO. 11168000
LOS GATOS CREEK AT
LOS GATOS, CA

Station #11168000 -LOS GATOS CREEK AT LOS GATOS, CALIF.

DATE	Flow (cfs)	Cond (µmohs)	TDS (mg/l)	pH	Temp (deg C)	Turbidity (NTU)	DO (mg/l)	DO (% sat)	Organic C (mg/l as C)	TH (mg/l as CaCO3)	Alkalinity (mg/l as CaCO3)
1/12/80	62.0	217.0	125.0		13.0	100.0	10.1		7.6	94.0	79.0
1/29/81		340.0	191.2			160.0				140.0	
1/4/82		156.0	102.9			570.0				76.0	
1/20/82		341.0	191.2			22.0				160.0	
1/19/83	28.0	321.0	198.5	7.9	8.0	29.0	11.2	96	3.5	150.0	120.0
1/26/83		180.0	110.3			370.0				80.0	
1/15/85	0.4	530.0	323.5	8.1	7.5	0.5	13.4	112	1.6	270.0	222.0
1/29/85	0.3	539.0	323.5	7.8	7.5	0.3	12.4	104	2.5	260.0	222.0
1/26/86	4.1	488.0	294.1	8.0	11.0	24.0	10.8	99		230.0	148.0
2/19/80	99.0	186.0	117.6	7.4	12.0	550.0	10.1		5.0	81.0	75.0
2/16/82		286.0	169.1			120.0				130.0	
2/7/83		241.0	154.4			150.0				110.0	
2/27/84		343.0	205.9			16.0				150.0	
2/8/85	34.0	231.0	125.0	8.0	9.5	64.0	11.0	97		110.0	72.0
2/13/86	2.0	327.0	191.2	8.2	12.0	130.0	9.2	86		150.0	131.0
2/24/86	181.0	146.0	117.6	7.9		350.0	10.4			80.0	66.0
3/5/80		262.0	161.8			110.0				110.0	87.0
3/4/81		413.0	235.3			54.0				180.0	
3/26/81		414.0	235.3			70.0				180.0	
3/30/82	259.0	301.0	183.8	8.0	10.5	21.0	11.0	100	3.0	130.0	106.0
3/1/83			132.3			220.0				98.0	
3/17/84	22.0	340.0	198.5	8.1	11.0	7.6	10.9	99	2.9	150.0	126.0
3/10/85	16.0	400.0	235.3	8.2	11.0	28.0	11.4	104		170.0	
3/4/86	113.0	208.0	117.6	8.0	13.0	170.0	10.2	98		87.0	70.0
3/11/86	324.0	220.0	125.0	8.2	14.0	88.0	9.6	94		95.0	79.0
4/11/83			169.1			1.4				120.0	
4/15/86	47.0	244.0	139.7	8.1	13.0	53.0	10.2	98		100.0	89.0
5/6/80	19.0	281.0	176.5	8.0	13.0	36.0	10.9	104	6.1	130.0	98.0
5/18/81		421.0	250.0			19.0				180.0	
5/17/82		266.0	161.8			17.0				120.0	
5/16/83		271.0	169.1			19.0				120.0	
5/13/86	30.0	246.0	154.4	8.1	13.0	2.0	10.2	98		110.0	92.0
6/11/84			205.9			5.1				160.0	
6/11/85	46.0	515.0	330.9	8.3	19.0	6.5	9.0	99	3.7	250.0	176.0
6/10/86	52.0	252.0	154.4	8.3	15.0	1.5	10.8	108		110.0	98.0
7/16/80		292.0	176.5			12.0				130.0	100.0
7/13/81		455.0	279.4			6.1				210.0	
7/19/82		274.0	169.1			15.0				120.0	

7/12/83	60.0	281.0	169.1	8.0	13.5	8.4	10.3	101	1.9	120.0	110.0
7/10/84	23.0	355.0	205.9	8.3	14.0	2.2	10.7	106		160.0	125.0
7/24/85	5.3	711.0	441.1	8.3	22.5	7.0	8.5	100		360.0	285.0
7/22/86	37.0	283.0	176.5	8.2	15.0	2.0	11.0	110		110.0	110.0
8/1/81		532.0	323.5			11.0				250.0	
8/29/83		285.0	176.5			4.0				140.0	
8/27/84	46.0	365.0	220.6	8.1	20.0	2.1	9.3	103	3.0	170.0	137.0
8/20/86	58.0	291.0	169.1	8.0	17.0	4.4	10.6	111		120.0	107.0
9/10/80		331.0	191.2			11.0				150.0	110.0
9/8/82	67.0	270.0	169.1	7.5	13.5	2.7	10.3	100	2.2	120.0	102.0
9/11/85	4.8	550.0	352.9	8.0	12.0	43.0	10.0	94		280.0	236.0
9/23/86	0.2	380.0	242.6	8.1	15.0	0.7	10.0	100		180.0	167.0
11/20/79	9.2	445.0	308.8	8.2	13.0	12.0	10.3		7.2	220.0	160.0
11/18/80		385.0	213.2			16.0				160.0	
11/16/81		347.0	205.9			15.0				160.0	
11/16/82	59.0	337.0	205.9	8.2	14.0	3.5	10.0	99	3.4	150.0	130.0
12/30/81	5.9	380.0	213.2	8.1	11.5	4.2	10.7	99	5.2	180.0	166.0
12/18/85	2.9	664.0	441.1	8.3	8.0	3.5	11.6	98		320.0	199.0

Station #11168000 -LOS GATOS CREEK AT LOS GATOS, CALIF.

Period	Flow (cfs)	Cond (µmohs)	TDS (mg/l)	pH	Temp (deg C)	Turbidity (NTU)	DO (mg/l)	DO (% sat)	Organic C (mg/l as C)	TH (mg/l as CaCO3)	Alkalinity (mg/l as CaCO3)
All											
Mean	53.7	342.2	205.9	8.1	13.0	67.3	10.5	101	3.9	155.0	129.4
CV	1.38	0.35	0.37	0.03	0.26	1.84	0.09	0.05	0.48	0.40	0.41
n	32	53	56	31	31	56	32	28	15	56	34
Month											
Nov	34.1	378.5	233.4	8.2	13.5	11.6	10.2	99	5.3	172.5	145.0
Jan	14.8	377.8	228.6	8.0	9.5	116.7	11.5	101	4.1	178.2	165.1
Feb	79.0	251.4	154.4	7.9	11.2	197.1	10.2	92	5.0	115.9	86.0
Mar	130.2	311.3	175.8	8.1	12.1	74.8	10.6	99	3.0	129.1	92.8
May	24.5	297.0	182.3	8.1	13.0	18.6	10.6	101	6.1	132.0	95.0
Jun	49.0	383.5	230.4	8.3	17.0	4.4	9.9	104	3.7	173.3	137.0
July	31.3	378.7	231.1	8.2	16.3	7.5	10.1	104	1.9	172.9	146.0
August	52.0	368.3	222.4	8.1	18.5	5.4	10.0	107	3.0	170.0	122.0
Sept	24.0	382.8	239.0	7.9	13.5	14.4	10.1	98	2.2	182.5	153.8
Winter											
Nov-Apr	66.8	330.1	195.8	8.0	11.1	107.1	10.8	98.9	4.2	147.9	123.5
n	19	31	33	18	18	33	19	15	10	33	19
Summer											
May-Oct	34.5	359.4	220.3	8.1	15.6	10.3	10.1	102.6	3.4	165.2	136.9
n	13	22	23	13	13	23	13	13	5	23	15

C V = Coefficent of Variation
n = Sample number

Station #11168000 -LOS GATOS CREEK AT LOS GATOS, CALIF.

DATE	Flow (cfs)	Total Phosphorous (mg/l as P)	Dis. Ortho P (mg/l as P)	Boron (mg/l as B)	Iron (mg/l as Fe)	Nitrogen NO2+NO3 (mg/l as N)	Dis. Ammonia (mg/l as N)	Total Organic N (mg/l as N)	Total ORG+NH3 (mg/l as N)	Total Nitrogen (mg/l as N)
1/12/80	62.0	0.19	0.03	60.0	40.00	0.66	0.04	1.70	1.80	2.50
1/29/81		0.12	0.01	50.0	60.00	0.89	0.07			
1/4/82		0.16	0.05	30.0	970.00	0.83	0.08	0.70	0.81	1.70
1/20/82		0.06	0.03	50.0	110.00	0.48	0.17	0.45	0.65	1.10
1/19/83	28.0	0.05	0.02	50.0	17.00	0.26	0.06		0.70	1.00
1/26/83		0.38	0.03	30.0	110.00	0.31	0.06	1.20	1.50	1.80
1/15/85	0.4	0.01	0.01	100.0	17.00	0.10	0.01		0.20	
1/29/85	0.3	0.01	0.01	100.0	11.00	0.10	0.02		0.30	
1/26/86	4.1	0.12	0.03	80.0	22.00		0.10	0.68	0.80	1.80
2/19/80	99.0	0.72	0.02	40.0	50.00	0.78	0.04	2.20	2.40	3.20
2/16/82		0.06	0.02	50.0	22.00	0.38	0.08	0.37	0.47	0.88
2/7/83		0.12	0.06	40.0	9.00	0.23	0.12	0.84	0.90	1.10
2/27/84		0.06	0.02	50.0	14.00	0.10	0.03	0.78	0.80	0.90
2/8/85	34.0	0.14	0.03	40.0	170.00	1.10	0.01	1.30	1.30	2.40
2/13/86	2.0	0.08	0.04	70.0			0.05	0.82	0.90	1.70
2/24/86	181.0	0.20	0.02	40.0	130.00		0.07	0.74	0.90	1.60
3/5/80		0.14	0.03	60.0	110.00	0.41	0.03	0.84	0.90	1.30
3/4/81		0.11	0.01	50.0	20.00	0.69	0.03	0.71	0.77	1.50
3/26/81		0.12	0.00	40.0	20.00	0.48	0.00	1.50	1.50	2.00
3/30/82	259.0	0.03	0.03	50.0	15.00	0.33	0.12	0.26	0.41	0.74
3/1/83		0.18	0.01	30.0	40.00	0.22	0.14	0.66	0.80	1.00
3/17/84	22.0	0.03	0.03	50.0	12.00	0.18	0.02	0.27	0.30	0.50
3/10/85	16.0	0.04	0.01	60.0	30.00	0.35	0.01	0.57	0.60	1.00
3/4/86	113.0	0.17	0.02	40.0	47.00		0.03	0.44	0.50	1.20
3/11/86	324.0	0.13	0.02	40.0	110.00		0.02	0.32	0.40	1.00
4/11/83		0.06	0.03	40.0	19.00	0.21	0.08	0.28	0.40	0.60
4/15/86	47.0	0.06	0.03	40.0	15.00		0.02	0.26	0.30	0.90
5/6/80	19.0	0.05	0.01	50.0	30.00	0.32	0.01	0.53	0.63	0.91
5/18/81		0.08	0.03	30.0	20.00	0.51	0.08	1.00	1.20	1.70
5/17/82		0.07	0.03	40.0	13.00	0.19	0.12	0.52	0.64	0.84
5/16/83		0.04	0.01	40.0	20.00	0.15	0.08	0.08	0.20	0.40
5/13/86	30.0	0.05	0.02	50.0	9.00		0.02	0.28	0.30	0.80
6/11/84		0.04	0.02	50.0	10.00	0.20	0.01	0.28	0.30	0.50
6/11/85	46.0	0.03	0.01	80.0	3.00	0.10	0.03	0.46	0.50	
6/10/86	52.0	0.05	0.03	50.0	37.00		0.01	0.26	0.30	0.80
7/16/80		0.06	0.01	70.0	10.00	0.46	0.01	0.49	0.50	0.96
7/13/81		0.10	0.02	60.0	10.00	0.25	0.10	0.81	1.00	1.30
7/19/82		0.04	0.02	50.0	7.00	0.29	0.08			

7/12/83	60.0	0.05	0.02	40.0	17.00	0.13	0.04	0.36	0.40	0.50
7/10/84	23.0	0.01	0.02	50.0	5.00	0.13	0.01	0.27	0.30	0.40
7/24/85	5.3			70.0	9.00					
7/22/86	37.0	0.04	0.01	50.0	5.00		0.02	0.39	0.40	0.80
8/1/81		0.07	0.00	70.0	10.00	0.16	0.06	0.85	0.71	0.84
8/29/83		0.03	0.02	40.0	5.00	0.16	0.08	0.61	0.70	0.90
8/27/84	46.0	0.04	0.03	50.0	31.00	0.10	0.01	0.24	0.30	
8/20/86	58.0	0.02	0.01	40.0	7.00		0.04		0.20	
9/10/80		0.07	0.03	70.0	10.00	0.11	0.04	0.46	0.49	0.62
9/8/82	67.0	0.04	0.01	50.0	4.00	0.27	0.08	0.34	0.60	0.90
9/11/85	4.8	0.35	0.02	110.0	36.00	0.16	0.51	2.00	2.50	2.70
9/23/86	0.2	0.02	0.01	70.0	16.00		0.03		0.20	
11/20/79	9.2	0.01	0.01	80.0	10.00	0.12	0.04	0.41	0.48	0.57
11/18/80		0.03	0.01	60.0	10.00	0.12	0.02			
11/16/81		0.05	0.05	60.0	97.00	0.85	0.14	0.44	0.59	1.50
11/16/82	59.0	0.01	0.01	50.0	5.00	0.10	0.10	0.99	1.10	
12/30/81	5.9	0.04	0.03	70.0	68.00	0.49	0.08	0.45	0.57	1.10
12/18/85	2.9	0.02	0.01	90.0	8.00		0.05	0.45	0.50	1.60

Station #11168000 -LOS GATOS CREEK AT LOS GATOS, CALIF.

Period	Flow (cfs)	Total Phosphorous (mg/l as P)	Dis. Ortho P (mg/l as P)	Boron (mg/l as B)	Iron (mg/l as Fe)	Nitrogen NO2+NO3 (mg/l as N)	Dis. Ammonia (mg/l as N)	Total Organic N (mg/l as N)	Total ORG+NH3 (mg/l as N)	Total Nitrogen (mg/l as N)
All										
Mean	53.7	0.09	0.02	54.8	49.31	0.34	0.06	0.66	0.71	1.20
CV	1.38	1.24	0.57	0.33	2.67	0.76	1.19	0.70	0.70	0.53
n	32	55	55	56	55	43	55	47	52	45
Month										
Nov	34.1	0.03	0.02	62.5	30.50	0.30	0.08	0.61	0.72	1.04
Jan	14.8	0.11	0.02	64.5	130.27	0.46	0.07	0.80	0.78	1.58
Feb	79.0	0.20	0.03	47.1	65.83	0.52	0.06	1.01	1.10	1.68
Mar	130.2	0.10	0.02	45.5	39.82	0.36	0.05	0.56	0.63	1.07
May	24.5	0.06	0.02	42.0	18.40	0.29	0.06	0.48	0.59	0.93
Jun	49.0	0.04	0.02	60.0	16.67	0.15	0.02	0.33	0.37	0.65
July	31.3	0.05	0.02	55.7	9.00	0.25	0.04	0.46	0.52	0.79
August	52.0	0.04	0.02	50.0	13.25	0.14	0.05	0.57	0.48	0.87
Sept	24.0	0.12	0.02	75.0	16.50	0.18	0.17	0.93	0.95	1.41
Winter										
Nov-Apr	66.8	0.11	0.02	54.2	74.6	0.41	0.06	0.74	0.79	1.36
n	19	33	33	33	32	26	33	28	31	28
Summer										
May-Oct	34.5	0.06	0.02	55.7	14.1	0.22	0.07	0.54	0.59	0.93
n	13	22	22	23	23	17	22	19	21	17

C V = Coefficent of Variation
n. = Sample number

Station #11168000 - LOS GATOS CREEK AT LOS GATOS, CALIF.

DATE	Flow (cfs)	Zn Dissolved (µg/l)	Zn Sediment (µg/gm)	Pb Dissolved (µg/l)	Pb Sediment (µg/gm)	Cu Dissolved (µg/l)	Cu Sediment (µg/gm)	As Dissolved (µg/l)	As Sediment (µg/gm)
1/4/82		10	--	6	--	4	--	1	--
1/26/83		28	20	1	30	3	10	1	2
2/19/80	99	10	--	5	--	1	--	1	--
2/8/85	34	3	50	1	50	2	30	1	2
2/24/86	181	20	--	1	--	1	--	1	--
3/26/81		50	--	3	--	2	--	2	--
6/11/85	46	10	--	4	--	1	--	1	--
8/1/81		20	--	2	--	4	--	2	--
8/29/83		9	--	1	--	2	--	1	--
8/27/84	46	9	40	1	50	1	30	1	1
9/10/80		60	--	3	--	1	--	2	--
9/8/82	67	3	--	1	--	1	--	1	--
9/11/85	5	10	120	1	30	1	70	3	7
All									
Mean	68	19	58	2	40	2	35	1	3
CV	0.8	0.9	0.7	0.7	0.3	0.6	0.6	0.5	0.8
n	7	13	4	13	4	13	4	13	4
Winter									
Mean	105	20	35	3	40	2	20	1	2
CV	0.6	0.8	0.4	0.7	0.3	0.5	0.5	0.3	0.0
n	3	6	2	6	2	6	2	6	2
Summer									
Mean	41	17	80	2	40	2	50	2	4
CV	0.5	1.0	0.5	0.6	0.3	0.7	0.4	0.5	0.8
n	4	7	2	7	2	7	2	7	2

C V = Coefficent of Variation
n = Sample number

Station #11168000 - LOS GATOS CREEK AT LOS GATOS, CALIF.

DATE	Flow (cfs)	Fe Sediment (µg/l)	Mn Dissolved (µg/l)	Mn Sediment (µg/gm)	Al Dissolved (µg/l)	Al Sediment (µg/gm)	Co Sediment (µg/gm)
1/4/82		--	50	--	90	--	--
1/26/83		4500	3	240	20	3300	10
2/19/80	99	--	0	--	80	--	--
2/8/85	34	23000	22	660	120	15000	20
2/24/86	181	--	10	--	70	--	--
3/26/81		--	20	--	10	--	--
6/11/85	46	--	30	--	10	--	--
8/1/81		--	40	--	10	--	--
8/29/83		--	1	--	10	--	--
8/27/84	46	13000	280	640	10	9300	10
9/10/80		--	230	--	10	--	--
9/8/82	67	--	2	--	10	--	--
9/11/85	5	22000	420	270	150	11000	20
All							
Mean	68	15625	85	453	46	9650	15
CV	0.8	0.5	1.5	0.4	1.0	0.4	0.3
n	7	4	13	4	13	4	4
Winter							
Mean	105	13750	18	450	65	9150	15
CV	0.6	0.7	0.9	0.5	0.6	0.6	0.3
n	3	2	6	2	6	2	2
Summer							
Mean	41	17500	143	455	30	10150	15
CV	0.5	0.3	1.1	0.4	1.6	0.1	0.3
n	4	2	7	2	7	2	2

C V = Coefficent of Variation
n = Sample number

Station #11168000 - LOS GATOS CREEK AT LOS GATOS, CALIF.

DATE	Flow (cfs)	Cd Dissolved (µg/l)	Cd Sediment (µg/gm)	Cr Dissolved (µg/l)	Cr Sediment (µg/gm)	Hg Dissolved (µg/l)	Hg Sediment (µg/gm)	Ni AS NI) (01065)	Se Dissolved (µg/l)	Se Sediment (µg/gm)
1/4/82		1	--	<10	--	<0.1	--	<100	--	--
1/26/83		<1	<1	<10	20	<0.1	0.05	<100	--	<1
2/19/80	99	0	--	0	--	0.00	--	0	--	--
2/8/85	34	<1	<1	<10	70	<0.1	0.05	<100	<1	<1
2/24/86	181	<1	--	<10	--	<0.1	--	<100	--	--
3/26/81		2	--	10	--	0.00	--	100	--	--
6/11/85	46	1	--	<10	--	<0.1	--	<100	--	--
8/1/81		0	--	10	--	0.00	--	0	--	--
8/29/83		<1	--	<10	--	<0.1	--	<100	--	--
8/27/84	46	<1	<1	10	50	<0.1	0.69	<100	--	<1
9/10/80		0	--	0	--	0.00	--	0	--	--
9/8/82	67	<1	--	<10	--	<0.1	--	<100	--	--
9/11/85	5	1	1	<10	380	<0.1	0.20	<100	--	1

Station #11168000 - LOS GATOS CREEK AT LOS GATOS, CALIF.

DATE	Total Diazinon (μg/l)	Total 2,4-D, (μg/l)	Total Lindane (μg/l)	Total Malathion (μg/l)	Total Chlordane (μg/l)	Total DDD (μg/l)	Total DDE (μg/l)	Total DDT (μg/l)	Total Dieldrin (μg/l)	Total Heptachlor (μg/l)
2/19/80	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9/10/80	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3/27/81	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9/1/81	0.00	0.01	0.00	0.07	0.00	0.00	0.00	0.00	0.00	0.00
1/5/82	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9/8/82	<0.01	<0.01	<0.010	<0.01	<0.1	<0.010	<0.010	<0.010	<0.010	<0.010
4/12/83	<0.01	<0.01	<0.010	<0.01	<0.1	<0.010	<0.010	<0.010	<0.010	<0.010
8/30/83	<0.01	<0.01	<0.010	<0.01	<0.1	<0.010	<0.010	<0.010	<0.010	<0.010
8/27/84	<0.01	--	<0.010	<0.01	<0.1	<0.010	<0.010	<0.010	<0.010	<0.010
2/8/85	<0.01	<0.01	<0.010	<0.01	<0.1	<0.010	<0.010	<0.010	<0.010	<0.010
9/11/85	<0.01	<0.01	<0.010	<0.01	<0.1	<0.010	<0.010	<0.010	<0.010	<0.010
1/29/86	0.03	0.02	<0.010	<0.01	<0.1	<0.010	<0.010	<0.010	<0.010	<0.010

Station #11168000 - LOS GATOS CREEK AT LOS GATOS, CALIF.

DATE	Total Naphthalenes Polychlor (µg/l)	Total PCB (µg/l)	Total Aldrin (µg/l)	Total Endosulfan (µg/l)	Total Endrin (µg/l)	Total Ethion (µg/l)	Total Chlor Epoxide (µg/l)	Total Oxychlor (µg/l)	Total Methyl Parathion (µg/l)
2/19/80	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9/10/80	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3/27/81	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9/1/81	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1/5/82	0.00	0.00	0.00	0.00	0.00	0.00	--	0.00	0.00
9/8/82	<0.10	<0.1	<0.010	<0.010	<0.010	<0.01	<0.010	<0.01	<0.01
4/12/83	<0.10	<0.1	<0.010	<0.010	<0.010	<0.01	<0.010	<0.01	<0.01
8/30/83	<0.10	<0.1	<0.010	<0.010	<0.010	<0.01	<0.010	<0.01	<0.01
8/27/84	<0.10	<0.1	<0.010	<0.010	<0.010	<0.01	<0.010	<0.01	<0.01
2/8/85	<0.10	<0.1	<0.010	<0.010	<0.010	<0.01	<0.010	<0.01	<0.01
9/11/85	<0.10	<0.1	<0.010	<0.010	<0.010	<0.01	<0.010	<0.01	<0.01
1/29/86	<0.10	<0.1	<0.010	<0.010	<0.010	<0.01	<0.010	<0.01	<0.01

Station #11168000 - LOS GATOS CREEK AT LOS GATOS, CALIF.

DATE	Total Methyl Trithion (µg/l)	Total Mirex (µg/l)	Total Perthane (µg/l)	Total Toxaphene (µg/l)	Total Trithion (µg/l)	Total 2,4,5-T (µg/l)	Total Silvex (µg/l)
2/19/80	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9/10/80	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3/27/81	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9/1/81	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1/5/82	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9/8/82	<0.01	<0.01	<0.1	<1	<0.01	<0.01	<0.01
4/12/83	<0.01	<0.01	<0.1	<1	<0.01	<0.01	<0.01
8/30/83	<0.01	<0.01	<0.1	<1	<0.01	<0.01	<0.01
8/27/84	<0.01	<0.01	<0.1	<1	<0.01	--	--
2/8/85	<0.01	<0.01	<0.1	<1	<0.01	<0.01	<0.01
9/11/85	<0.01	<0.01	<0.1	<1	<0.01	<0.01	<0.01
1/29/86	<0.01	<0.01	<0.1	<1	<0.01	<0.01	<0.01

USGS STATION NO. 11171500
COYOTE CREEK NEAR
EDENVALE, CA

Station #11171500 - COYOTE C NR EDENVALE CALIF

Date	Flow (cfs)	Cond (µmohs)	TDS (mg/l)	pH	Temp (deg C)	Turbidity (NTU)	DO (mg/l)	DO (% sat)	Dis. Organic C (mg/l as C)	TH (mg/l as CaCO3)	Alkalinity (mg/l as CaCO3)
1/17/79	5.1	560.0	316.2	7.4	9.5		8.9			240.0	170.0
1/11/80		146.0	95.6			620.0				69.0	70.0
1/29/81		525.0	279.4			110.0				220.0	
1/5/82		195.0	102.9			270.0				83.0	
1/21/82		363.0	205.9			130.0				160.0	
1/19/83		526.0	301.4			44.0				230.0	
1/28/83	841.0	294.0	176.5	7.8	10.5	320.0	10.0	91	5.6	130.0	118.0
1/30/86	1.8	79.0	44.1	7.7	11.5	65.0	8.0	74		28.0	31.0
2/14/79	0.0	73.0	36.8	7.0	15.5		9.7			26.0	21.0
2/20/80	331.0	270.0	169.1	7.2	13.5	210.0	9.0		12.0	120.0	100.0
2/18/82	22.0	570.0	308.8	8.0	13.5	8.8	8.4	80	6.6	250.0	204.0
2/9/83	3300.0	311.0	183.8	8.0	10.5	210.0	10.6	95	5.3	140.0	124.0
2/28/84			382.3							300.0	
2/9/85	16.0	621.0	360.3	8.0	10.0	24.0	10.2	90		290.0	216.0
2/14/86	32.0	344.0	191.2	8.3	13.5	42.0	8.9	86		150.0	125.0
2/25/86	42.0	515.0	308.8	8.1	15.0	25.0	10.1	101		230.0	198.0
3/16/79	0.4	391.0	213.2	7.8	16.5		8.2			170.0	110.0
3/27/79	1.4	66.0	36.8	7.5	14.5		9.0			23.0	16.0
3/7/80	41.0	513.0	301.4	7.4	12.0	28.0	8.8		12.0	230.0	200.0
3/5/81		541.0	316.2			81.0				240.0	
3/28/81	3.8	605.0	345.6	8.2	13.5	3.5	7.8	75	7.8	270.0	210.0
3/31/82	486.0	239.0	125.0	7.9	10.5	48.0	10.0	90	4.9	100.0	92.0
3/2/83	5900.0	273.0	176.5	8.1	11.5	370.0	10.0	95	5.0	130.0	114.0
3/12/86	89.0	475.0	272.0	8.2	13.5	25.0	9.4	91		210.0	185.0
4/13/83	502.0	381.0	198.5	8.1	11.0	35.0	10.6	96	3.4	150.0	130.0
4/26/79	0.4	213.0	110.3	7.1	19.0		3.9			88.0	80.0
5/23/79	0.4	435.0	279.4	7.6	20.5		7.4			210.0	180.0
5/18/82	3.0	618.0	360.3	8.2	20.5	0.5	9.3	104	2.1	280.0	228.0
5/17/83		366.0	213.2			45.0				150.0	
5/14/86	5.2	463.0	272.0	8.2	17.5	2.1	7.2	76		200.0	176.0
7/31/79	0.3	431.0	250.0	7.6	28.0		5.5			170.0	170.0
7/17/80		406.0	227.9			4.4				170.0	150.0
7/15/81	1.9	383.0	242.6	8.0	20.5	0.8	5.8	65	6.1	170.0	150.0
7/20/82		457.0	264.7			76.0				200.0	
7/12/83		426.0	257.3			180.0				190.0	
7/11/34	4.6	488.0	286.7	8.2	22.0	1.6	6.0	69		230.0	179.0
8/30/83		556.0	294.1			150.0				220.0	
9/10/80	0.5	403.0	242.6	7.4	19.0	0.5	6.0		4.5	180.0	160.0

9/2/81	0.9	380.0	220.6	7.8	18.0	0.7	5.6	60	3.3	160.0	150.0
9/7/82	5.5	442.0	250.0	7.7	20.5	0.8	6.8	76	3.3	190.0	158.0
9/24/86	2.1	357.0	220.6	7.9	16.5	0.5	6.8	71		160.0	141.0
11/17/81		527.0	294.1			30.0				230.0	
11/16/82		512.0	286.7			30.0				220.0	
12/31/81	0.6	489.0	279.4	7.4	11.0	5.6	5.5	50	3.7	210.0	164.0

Station #11171500 - COYOTE C NR EDENVALE CALIF

Period	Flow (cfs)	Cond (µmohs)	TDS (mg/l)	pH	Temp (deg C)	Turbidity (NTU)	DO (mg/l)	DO (% sat)	Dis. Organic C (mg/l as C)	TH (mg/l as CaCO3)	Alkalinity (mg/l as CaCO3)
All											
Mean	388.0	400.7	234.1	7.8	15.3	88.8	8.1	82	5.7	177.7	141.3
CV	3.12	0.37	0.37	0.05	0.29	1.49	0.23	0.18	0.52	0.38	0.39
n	30	43	44	30	30	36	30	20	15	44	32
Month											
Nov		519.5	290.4			30.0				225.0	
Jan	212.1	353.0	200.1	7.6	10.6	195.6	8.1	72	4.7	152.2	110.6
Feb	534.7	386.3	242.6	7.8	13.1	86.6	9.6	90	8.0	188.3	141.1
Mar	878.0	387.1	220.6	7.9	12.9	84.4	9.2	89	6.6	169.2	132.1
May	2.3	419.0	247.0	7.8	19.4	15.9	7.0	90	2.1	185.6	166.0
July	2.3	431.8	254.9	7.9	23.5	52.6	5.8	67	6.1	188.3	162.3
Sept	2.3	395.5	233.4	7.7	18.5	0.6	6.3	69	3.7	172.5	152.3
Winter											
Nov-Apr	611.3	385	225	7.8	12.5	118.9	9.1	85.7	6.6	173.2	129.9
CV	2.44	0.45	0.45	0.05	0.16	1.28	0.13	0.16	0.47	0.46	0.49
n	19	27	28	19	19	23	19	13	10	28	20
Summer											
May-Oct	2.3	427	250	7.8	20.2	35.6	6.4	74.4	3.9	185.5	160.2
CV	0.90	0.21	0.21	0.05	0.15	1.74	0.21	0.19	0.39	0.22	0.21
n	11	16	16	11	11	13	11	7	5	16	12

Station #11171500 - COYOTE C NR EDENVALE CALIF

Date	Flow (cfs)	Total Phosphorous (mg/l as P)	Dis Ortho P (mg/l as P)	Boron (mg/l as B)	Iron (mg/l as Fe)	Nitrogen NO3+NO2 (mg/l as N)	Dis. Ammonia (mg/l as N)	Total Organic (mg/l as N)	Total ORG+NH3 (mg/l as N)	Total Nitrogen (mg/l as N)
1/17/79	5.1	0.19	0.07	130.0	60.0	4.90	0.04	1.10	1.20	5.90
1/11/80		0.65	0.13	50.0	70.0	0.95	0.03	2.40	2.50	3.50
1/29/81		0.25	0.04	100.0	20.0	4.00	0.04			
1/5/82		0.41	0.24	50.0	230.0	1.20	0.09	1.30	1.50	2.70
1/21/82		0.23	0.16	70.0	350.0	2.00	0.22	1.10	1.30	3.30
1/19/83		0.19	0.08	100.0	19.0	4.00	0.06	1.20	1.30	5.30
1/28/83	841.0	0.34	0.10	70.0	75.0	0.93	0.06	1.50	1.70	2.60
1/30/86	1.8	0.22	0.14	40.0	120.0	0.40	0.18	0.15	1.40	1.80
2/14/79	0.0	0.22	0.09	20.0	40.0	0.31	0.08	0.46	0.54	0.82
2/20/80	331.0	0.59	0.23	90.0	130.0	1.70	0.09	1.70	1.90	3.60
2/18/82	22.0	0.08	0.05	130.0	53.0	3.50	0.07	1.20	1.30	4.80
2/9/83	3300.0	0.31	0.06	70.0	28.0	0.34	0.12		1.60	1.90
2/28/84		0.26	0.01	130.0	37.0	5.90	0.03	2.20	2.30	8.10
2/9/85	16.0	0.02	0.02	130.0	3.0	5.60	0.01	0.01	1.80	7.40
2/14/86	32.0	0.08	0.03	100.0	21.0	1.80	0.05	0.06	0.60	2.40
2/25/86	42.0	0.15	0.11	110.0	36.0	2.70	0.08	0.07	0.80	3.50
3/16/79	0.4	0.19	0.09	110.0	20.0	2.80	0.01	0.92	0.94	3.50
3/27/79	1.4	0.12	0.08	50.0	40.0	0.19	0.06	0.37	0.43	0.62
3/7/80	41.0	0.15	0.12	120.0	20.0	3.10	0.04	1.20	1.20	4.30
3/5/81		0.28	0.01	120.0	10.0	1.80	0.03	1.80	1.90	5.70
3/28/81	3.8	0.04	0.00	100.0	20.0	4.20	0.04	1.20	1.30	5.40
3/31/82	486.0	0.18	0.08	60.0	66.0	0.51	0.11	0.66	0.82	1.30
3/2/83	5900.0	0.45	0.02	70.0	100.0	0.34	0.14	2.30	2.40	2.80
3/12/86	89.0	0.14	0.08	100.0	65.0	2.00	0.14	0.10	0.80	2.80
4/13/83	502.0	0.05	0.02	70.0	18.0	0.88	0.08	0.60	0.70	1.60
4/26/79	0.4	0.37	0.13	100.0	600.0	0.06	0.03	1.20	1.40	1.50
5/23/79	0.4	0.05	0.05	210.0	10.0	0.12	0.01	0.42	0.49	0.59
5/18/82	3.0	0.03	0.02	120.0	9.0	4.40	0.10	0.65	0.78	5.30
5/17/83		0.11	0.02	80.0	11.0	0.93	0.06	1.00	1.10	2.00
5/14/86	5.2	0.01	0.01	100.0	7.0	2.00	0.03	0.03	0.50	2.50
7/31/79	0.3	0.02	0.03	130.0	20.0	0.02	0.03	0.24	0.24	0.29
7/17/80		0.08	0.01	120.0	10.0	1.00	0.01	2.20	2.20	3.20
7/15/81	1.9	0.05	0.02	90.0	30.0	0.20	0.12	0.63	0.85	1.10
7/20/82		0.08	0.03	100.0	3.0	1.70	0.09	1.80	1.90	3.50
7/12/83		0.35	0.03	90.0	5.0	1.90	0.07	1.80	1.90	3.80
7/11/84	4.6	0.01	0.02	110.0	3.0	1.00	0.05	0.01	0.50	1.50
8/30/83		0.28	0.01	100.0	9.0	2.50	0.05	2.20	2.30	4.80
9/10/80	0.5	0.03	0.00	110.0	30.0	0.95	0.05	0.45	0.48	1.40

9/2/81	0.9	0.04	0.00	90.0	31.0	0.04	0.12	0.57	0.68	0.70
9/7/82	5.5	0.03	0.01	110.0	3.0	2.00	0.13	0.77	1.00	3.00
9/24/86	2.1	0.03	0.02	100.0	23.0	1.20	0.03	0.04	0.50	1.70
11/17/81		0.11	0.09	100.0	23.0	3.70	0.08	0.82	1.00	4.80
11/16/82		0.11	0.01	100.0	3.0	3.40	0.06	1.90	2.00	5.40
12/31/81	0.6	0.09	0.06	90.0	36.0	4.30	0.09	0.99	1.10	5.40

Station #11171500 - COYOTE C NR EDENVALE CALIF

Period	Flow (cfs)	Total Phosphorous (mg/l as P)	Dis Ortho P (mg/l as P)	Boron (mg/l as B)	Iron (mg/l as Fe)	Nitrogen NO3+NO2 (mg/l as N)	Dis. Ammonia (mg/l as N)	Total Organic (mg/l as N)	Total ORG+NH3 (mg/l as N)	Total Nitrogen (mg/l as N)
All										
Mean	388.0	0.17	0.06	96.4	57.2	1.99	0.07	0.98	1.24	3.21
CV	3.12	0.88	0.97	0.33	1.84	0.82	0.65	0.74	0.50	0.59
n	30	44	44	44	44	44	44	42	43	43
Month										
Nov	0.0	0.11	0.05	100.0	13.0	3.55	0.07	1.36	1.50	5.10
Jan	212.1	0.29	0.11	77.8	108.9	2.52	0.09	1.22	1.50	3.81
Feb	534.7	0.21	0.08	97.5	43.5	2.73	0.07	0.81	1.36	4.07
Mar	878.0	0.18	0.06	88.9	39.9	1.76	0.07	1.02	1.17	3.11
May	2.3	0.11	0.05	122.0	127.4	1.50	0.05	0.66	0.85	2.38
July	2.3	0.10	0.02	106.7	11.8	0.97	0.06	1.11	1.27	2.23
Sept	2.3	0.03	0.01	102.5	21.8	1.05	0.08	0.46	0.67	1.70
Winter										
Nov-Apr	611.3	0.22	0.08	88.6	61.2	2.41	0.08	1.05	1.35	3.75
CV	2.44	0.71	0.77	0.34	1.21	0.72	0.65	0.68	0.43	0.51
n	19	28	28	28	28	28	28	26	27	27
Summer										
May-Oct	2.3	0.10	0.03	110.0	50.3	1.25	0.06	0.88	1.05	2.31
CV	0.90	1.23	1.19	0.27	2.92	0.93	0.65	0.86	0.65	0.65
n	11	16	16	16	16	16	16	16	16	16

Station # 11171500 - COYOTE CREEK NEAR EDENVALE CALIF.

DATE	Flow (cfs)	Zn dissolved (µg/l)	Zn sediment (µg/l)	PB dissolved (µg/l)	PB sediment (µg/l)	Cu dissolved (µg/l)	Cu sediment (µg/l)	As dissolved (µg/l)	As sediment (µg/l)
1/17/79	5	3	--	3	--	4	--	2	--
1/5/82		10	--	6	--	4	--	3	--
1/28/83	841	3	60	--	50	2	10	1	6
2/20/80	331	10	8	ND	5	3	4	3	8
2/9/85	16	3	60	1	210	1	20	1	3
2/14/86	32	20	--	3	--	1	--	1	--
2/25/86	42	10	--	4	--	1	--	3	--
3/28/81	4	10	110	6	80	2	8	1	7
7/31/79	89	3	--	ND	--	ND	--	1	--
8/30/83		100	--	1	--	2	--	1	--
9/10/80	1	50	100	2	150	1	20	1	6
9/2/81	1	10	90	3	50	1	10	1	10
9/7/82	6	30	30	1	20	9	7	1	7

	Flow (cfs)	Zn dissolved (µg/l)	Zn sediment (µg/l)	PB dissolved (µg/l)	PB sediment (µg/l)	Cu dissolved (µg/l)	Cu sediment (µg/l)	As dissolved (µg/l)	As sediment (µg/l)
All									
Mean	124	20	65	3	81	3	11	2	7
CV	2.0	1.3	0.5	0.6	0.8	0.9	0.5	0.5	0.3
n	11	13	7	10	7	12	7	13	7
Winter									
Mean	182	9	60	4	86	2	11	2	6
CV	1.6	0.6	0.6	0.5	0.9	0.5	0.6	0.5	0.3
n	7	8	4	6	4	8	4	8	4
Summer									
Mean	24	39	73	2	73	3	12	1	8
CV	1.5	0.9	0.4	0.5	0.8	1.0	0.5	0.0	0.2
n	4	5	3	4	3	4	3	5	3

Station # 11171500 - COYOTE CREEK NEAR EDENVALE CALIF.

DATE	Flow (cfs)	Fe sediment (µg/l)	Mn dissolved (µg/l)	Mn sediment (µg/l)	Al dissolved (µg/l)	Al sediment (µg/l)	Co sediment (µg/l)
1/17/79	5	--	6	--	10	--	--
1/5/82		--	10	--	40	--	--
1/28/83	841	9500	3	280	60	3900	20
2/20/80	331	150	10	190	60	ND	5
2/9/85	16	26000	--	580	10	9400	30
2/14/86	32	--	10	--	30	--	--
2/25/86	42	--	10	--	20	--	--
3/28/81	4	6000	10	190	10	1800	30
7/31/79	89	--	10	--	100	--	--
8/30/83		--	91	--	10	--	--
9/10/80	1	6100	10	290	10	1600	40
9/2/81	1	14000	ND	230	10	1000	20
9/7/82	6	4300	10	290	10	1500	10
All							
Mean	124	9436	16	293	29	3200	22
CV	2.0	0.8	1.4	0.4	0.9	0.9	0.5
n	11	7	11	7	13	6	7
Winter							
Mean	182	10413	8	310	30	5033	21
CV	1.6	0.9	0.3	0.5	0.7	0.6	0.5
n	7	4	7	4	8	3	4
Summer							
Mean	24	8133	30	270	28	1367	23
CV	1.5	0.5	1.2	0.1	1.3	0.2	0.5
n	4	3	4	3	5	3	3

Station # 11171500 - COYOTE CREEK NEAR EDENVALE CALIF.

DATE	Flow (cfs)	Cd dissolved (µg/l)	Cd sediment (µg/l)	Cr dissolved (µg/l)	Cr sediment (µg/l)	Hg dissolved (µg/l)	Hg sediment (µg/l)	Ni sediment (µg/l)	Se dissolved (µg/l)	Se sediment (µg/l)
1/17/79	5	5	--	ND	--	<0.1	--	ND	--	--
1/5/82		1	--	<10	--	<0.1	--	<100	--	--
1/28/83	841	<1	1	<10	50	<0.1	0.10	<100	--	<1
2/20/80	331	0	0	0	10	0.10	0.08	0	--	0
2/9/85	16	<1	<1	<10	160	<0.1	0.06	<100	<1	<1
2/14/86	32	1	--	<10	--	<0.1	--	<100	--	--
2/25/86	42	<1	--	<10	--	<0.1	--	<100	--	--
3/28/81	4	0	0	10	58	0.00	1.00	0	--	0
7/31/79	89	<2	--	ND	--	<0.1	--	ND	--	--
8/30/83		<1	--	10	--	<0.1	--	<100	--	--
9/10/80	1	1	1	0	58	0.00	0.14	0	--	--
9/2/81	1	0	<1	0	100	1.70	0.05	0	--	0
9/7/82	6	<1	<1	<10	20	<0.1	0.05	<100	--	<1

Station #11171500 - COYOTE C NR EDENVALE CALIF

DATE	Total Diazinon (µg/l)	Total 2,4-D, (µg/l)	Total Lindane (µg/l)	Total Malathion (µg/l)	Total Chlordane (µg/l)	Total DDD (µg/l)	Total DDE (µg/l)	Total DDT (µg/l)	Total Dieldrin (µg/l)	Total Heptachlor (µg/l)
2/20/80	0.05	0.98	0	0	0	0.01	0.04	0.04	0	0
9/10/80	0	0	0	0	0	0	0	0	0	0
3/28/81	0.07	0.08	0	0	0	0	0	0	0	0
9/2/81	<0.01	0.01	0	0.24	0	0	0	0	0	0
1/6/82	0.06	0.02	0	0.03	0	0.02	0.03	0	0.01	0
9/7/82	0.01	<0.01	<0.010	<0.01	<0.1	<0.010	<0.010	<0.010	<0.010	<0.010
1/28/83	0.03	<0.01	<0.020	<0.01	<0.2	<0.020	0.01	0.01	0.01	<0.020
4/13/83	0.02	0.01	<0.010	<0.01	<0.1	<0.010	<0.010	<0.010	<0.010	<0.010
8/31/83	<0.01	<0.01	<0.010	<0.01	<0.1	<0.010	<0.010	<0.010	<0.010	<0.010
2/9/85	0.04	<0.01	<0.010	<0.01	<0.1	<0.010	<0.010	<0.010	<0.010	<0.010
1/30/86	0.41	0.08	0.01	1.3	0.2	<0.010	0.01	<0.010	<0.010	<0.010
2/14/86	0.1	0.03	<0.010	0.03	<0.1	<0.010	<0.010	<0.010	<0.010	<0.010
2/25/86	0.02	0.01	<0.010	<0.01	<0.1	<0.010	<0.010	<0.010	<0.010	<0.010
9/24/86	0.02	0.02	<0.010	<0.01	<0.1	<0.010	<0.010	<0.010	<0.010	<0.010

Station #11171500 - COYOTE C NR EDENVALE CALIF

DATE	Total Naphthalenes Polychlor (µg/l)	Total PCB (µg/l)	Total Aldrin (µg/l)	Total Endosulfan (µg/l)	Total Endrin (µg/l)	Total Ethion (µg/l)	Total Chlor Epoxide (µg/l)	Total Oxychlor (µg/l)	Total Methyl Parathion (µg/l)
2/20/80	0	0	0	0	0.02	0	0	0	0
9/10/80	0	0	0	0	0	0	0	0	0
3/28/81	0	0	0	0	0	0	0	0	0
9/2/81	0	0	0	0	0	0	0	0	0
1/6/82	0	0	0	0	0.01	0	0	0	0
9/7/82	<0.10	<0.1	<0.010	<0.010	<0.010	<0.01	<0.010	<0.01	<0.01
1/28/83	<0.20	<0.2	<0.020	<0.020	<0.020	0.01	<0.020	<0.02	<0.01
4/13/83	<0.10	<0.1	<0.010	<0.010	<0.010	<0.01	<0.010	<0.01	<0.01
8/31/83	<0.10	<0.1	<0.010	<0.010	<0.010	<0.01	<0.010	<0.01	<0.01
2/9/85	<0.10	<0.1	<0.010	<0.010	<0.010	<0.01	<0.010	<0.01	<0.01
1/30/86	<0.10	<0.1	<0.010	<0.010	<0.010	<0.01	<0.010	<0.01	<0.01
2/14/86	<0.10	<0.1	<0.010	<0.010	<0.010	<0.01	<0.010	<0.01	<0.01
2/25/86	<0.10	<0.1	<0.010	<0.010	<0.010	0.01	<0.010	<0.01	<0.01
9/24/86	<0.10	<0.1	<0.010	<0.010	<0.010	<0.01	<0.010	<0.01	<0.01

Station #11171500 - COYOTE C NR EDENVALE CALIF

DATE	Total Methyl Trithion (µg/l)	Total Mirex (µg/l)	Total Perthane (µg/l)	Total Toxaphene (µg/l)	Total Trithion (µg/l)	Total 2,4,5-T (µg/l)	Total Silvex (µg/l)
2/20/80	0	0	0	0	0	0	0
9/10/80	0	0	0	0	0	0	0
3/28/81	0	0	0	0	0	0	0
9/2/81	0	0	0	0	0	0	0
1/6/82	0	0	0	0	0	0	0
9/7/82	<0.01	<0.01	<0.1	<1	<0.01	<0.01	<0.01
1/28/83	<0.01	<0.02	<0.2	<2	<0.01	<0.01	<0.01
4/13/83	<0.01	<0.01	<0.1	<1	<0.01	<0.01	<0.01
8/31/83	<0.01	<0.01	<0.1	<1	<0.01	<0.01	<0.01
2/9/85	<0.01	<0.01	<0.1	<1	<0.01	<0.01	<0.01
1/30/86	<0.01	<0.01	<0.1	<1	<0.01	<0.01	<0.01
2/14/86	<0.01	<0.01	<0.1	<1	<0.01	<0.01	<0.01
2/25/86	<0.01	<0.01	<0.1	<1	<0.01	<0.01	<0.01
9/24/86	<0.01	<0.01	<0.1	<1	<0.01	<0.01	<0.01

8720115A-F CON-6

USGS STATION NO. 11169970
COYOTE CREEK BELOW
LEROY ANDERSON DAM NEAR MADRONE, CA

STA 11 169 970 Coyote Creek - below Leroy Anderson dam - near Madrone CA

DATE	FLOW (inst) (CFS)	COND (US/CM)	TDS (mg/l)	pH	TEMP DEGC	TURBIDITY (NTU)	DO (mg/l)	DO (% sat)	DIS. ORGC (mg/l C)	TH mg/l CaCO3	ALK mg/l CaCO3
11/21/79	12	382	240	8.4	15.0	6	10.0	--	6.3	170	150
11/19/80	17	296	170	7.6	13.0	34	10.4	99	5.5	120	120
11/18/81	7.2	349	220	8.0	13.5	3	10.1	97	9.8	150	146
11/17/82	58	313	190	7.9	12.0	15	10.4	98	4.1	140	120
1/11/80	159	419	260	7.8	11.5	17	10.8	--	7.3	190	180
1/30/81	29	301	180	7.7	11.0	290	10.7	97	9.4	120	110
12/31/81	8.4	358	220	8.2	13.0	25	10.4	100	4.5	160	148
1/6/82	8.8	308	180	8.1	11.0	160	10.7	97	5.6	140	122
1/22/82	8	343	210	8.1	10.0	44	11.2	99	4.9	160	136
1/20/83	27	336	200	8.1	9.0	51	11.1	98	4.0	150	130
1/28/83	570	276	170	8.0	10.5	260	10.9	100	5.2	120	110
1/16/85	35	454	280	8.4	10.0	5	10.8	96	--	200	172
1/16/85	35	454	280	8.4	10.0	5	10.8	96	2.5	200	172
1/30/85	29	448	280	8.4	10.0	7	11.2	100	4.0	210	178
1/30/86	6.7	554	340	8.2	11.0	20	9.9	91	--	250	221
2/21/80	3.3	342	220	7.0	11.5	410	10.0	--	8.6	150	98
2/18/82	5.5	297	170	8.2	10.0	120	11.0	98	5.7	130	112
2/9/83	413	277	170	8.0	10.5	160	11.1	100	5.5	120	110
2/29/84	14	422	260	8.4	11.5	23	11.0	102	2.8	190	162
2/9/85	9.4	461	290	8.2	10.0	6	12.0	107	--	210	181
2/14/86	6.7	562	340	8.2	11.0	21	10.1	93	--	250	221
3/7/80	4.3	296	180	7.5	11.5	120	10.5	--	14.0	120	94
3/6/81	29	313	200	7.9	11.0	100	10.6	98	6.2	140	130
3/28/81	19	316	200	8.2	11.0	42	10.6	97	4.8	140	130
3/31/82	350	327	190	8.1	10.5	16	11.0	100	4.8	140	130
3/2/83	1000	250	160	8.2	11.0	310	10.4	98	5.4	110	100
3/16/84	24	428	250	8.2	11.5	12	11.2	103	2.7	180	164
3/11/85	9	463	280	8.3	10.5	4	13.5	122	--	210	170
3/12/86	20	291	160	8.2	13.5	78	10.1	98	--	120	102
4/13/83	432	324	170	8.1	11.5	43	10.9	101	3.9	120	110
5/7/80	40	271	170	7.6	12.0	20	10.7	100	9.8	120	98
5/20/81	52	325	200	8.0	12.0	26	10.6	99	7.8	140	130
5/18/82	21	314	170	8.1	11.0	14	11.0	101	4.1	130	122
5/18/83	371	305	190	8.1	12.0	20	10.8	101	3.2	130	120
5/14/86	46	264	150	8.1	13.0	28	10.0	96	--	99	98

6/13/84	64	--	250	8.3	13.5	3	10.2	--	--	190	--
6/14/85	77	472	280	8.3	12.5	6	10.8	103	--	210	172
7/17/80	59	281	170	7.4	12.0	18	10.4	97	5.2	120	100
7/15/81	65	337	210	8.1	13.0	14	10.2	98	7.8	140	130
7/21/82	63	312	190	8.0	12.0	20	10.7	100	4.6	130	122
7/13/83	62	321	200	8.1	13.5	18	10.5	102	3.1	140	120
7/11/84	70	423	260	8.2	15.0	7	10.5	106	--	190	162
7/25/85	59	472	280	8.2	14.5	14	10.0	100	--	210	179
7/24/86	64	253	170	8.1	13.5	20	10.9	105	--	120	104
8/31/83	62	396	210	8.1	14.0	20	9.9	98	2.8	150	130
8/28/84	71	435	260	8.0	15.0	8	9.8	98	3.8	190	166
9/9/80	60	289	170	7.5	13.0	24	10.2	97	6.8	120	110
9/2/81	73	334	200	8.0	13.0	8	10.2	98	3.4	140	130
9/7/82	68	314	180	7.7	12.0	11	10.6	100	4.4	130	114
9/12/85	70	498	300	8.2	18.5	7	9.4	101	--	230	189
9/24/86	60	272	170	7.7	14.5	27	9.8	98	--	120	105

STA 11 169 970 Coyote Creek - below Leroy Anderson dam - near Madrone CA

MONTHLY AND SEASONAL AVERAGES

PERIOD	FLOW (inst) (CFS)	COND (US/CM)	TDS (mg/l)	pH	TEMP DEGC	TURBIDITY (NTU)	DO (mg/l)	DO (% sat)	DIS. ORGC (mg/l C)	TH mg/l CaCO3	ALK mg/l CaCO3
ALL											
average	97	357	216	8.0	12.1	54	10.6	100	5.5	156	137
cov	1.84	0.22	0.23	0.04	0.15	1.63	0.06	0.04	0.44	0.25	0.24
MONTH											
NOV	24	335	205	8.0	13.4	14	10.2	98	6.4	145	134
JAN	83	386	236	8.1	10.6	80	10.8	97	5.3	173	153
FEB	75	394	242	8.0	10.8	123	10.9	100	5.7	175	147
MAR	182	336	203	8.1	11.3	85	11.0	102	6.3	145	128
APR	432	324	170	8.1	11.5	43	10.9	101	3.9	120	110
MAY	106	296	176	8.0	12.0	22	10.6	99	6.2	124	114
JUN	71	472	265	8.3	13.0	4	10.5	103	-	200	172
JULY	63	343	211	8.0	13.4	16	10.5	101	5.2	150	131
SEPT	67	357	213	7.9	14.3	14	10.0	99	4.6	155	136
NOV - APR	112	365	222	8.1	11.2	80	10.8	99	5.7	160	141
MAY - OCT	75	344	209	8.0	13.3	16	10.3	100	5.1	150	130

STA 11 169 970 Coyote Creek - below Leroy Anderson dam - near Madrone CA

DATE	FLOW (inst) (CFS)	DIS. BORON (ug/l B)	DIS. IRON (ug/l Fe)	TOTAL P (mg/l P)	DIS. ORTHO P (mg/l P)	NO2+NO3 (mg/l N)	DIS. AMMONIA (mg/l N)	TOTAL ORGANIC (mg/l N)	TOTAL ORG+NH3 (mg/l N)	TOTAL N (mg/l N)
11/21/79	12	120	70	0.01	0.01	0.11	0.04	0.99	1.10	1.20
11/19/80	17	80	20	0.05	0.02	0.52	0.04	0.65	0.69	1.20
11/18/81	7.2	80	10	0.03		0.24	0.29	0.35	0.65	0.89
11/17/82	58	80	16	0.02	0.01	0.30	0.13	1.30	1.40	1.70
1/11/80	159	100	10	0.04	0.01	0.16	0.01	0.91	0.91	1.10
1/30/81	29	70	40	0.13	0.02	0.54	0.05			
12/31/81	8.4	100	10	0.05	0.02	0.13	0.09	0.54	0.67	0.80
1/6/82	8.8	80	24	0.10	0.04	0.42	0.08	0.69	0.80	1.20
1/22/82	8	90	28	0.05	0.03	0.23	0.11	0.50	0.64	0.87
1/20/83	27	80	8	0.05	0.01	0.20	0.06		0.30	0.50
1/28/83	570	80	69	0.18	0.03	0.20	0.06	0.98	1.10	1.30
1/16/85	35	120	12							
1/16/85	35	100	8	0.01	0.01	0.10	0.01		0.30	
1/30/85	29	100	7	0.01	0.01	0.10	0.01	0.38	0.40	
1/30/86	6.7	130	13	0.03	0.01	0.10	0.07	0.35	0.40	
2/21/80	3.3	90	170	0.64	0.04	0.67	0.07	2.70	2.90	3.60
2/18/82	5.5	90	30	0.05	0.02	0.26	0.10	0.56	0.68	0.94
2/9/83	413	70	33	0.12	0.06	0.20	0.09	0.74	0.80	1.00
2/29/84	14	90	11	0.02	0.01	0.20	0.02	0.29	0.30	0.50
2/9/85	9.4	100	3	0.01	0.01	0.10	0.01		0.70	
2/14/86	6.7	130	4	0.02	0.01	0.10	0.14	0.55	0.70	0.80
3/7/80	4.3	90	20	0.09	0.04	0.46	0.01	0.65	0.72	1.20
3/6/81	29	80	390	0.09	0.02	0.26	0.04	0.75	0.82	1.10
3/28/81	19	70	10	0.06	0.01	0.27	0.02	0.46	0.49	0.76
3/31/82	350	100	30	0.03	0.02	0.25	0.08	0.45	0.54	0.79
3/2/83	1000	70	120	0.26	0.02	0.20	0.09	0.95	1.10	1.30
3/16/84	24	80	5	0.02	0.02	0.30	0.05	0.38	0.40	0.70
3/11/85	9	100	6	0.01	0.01	0.10	0.01	0.25	0.30	
3/12/86	20	90	110	0.09	0.02	0.50	0.02	0.26	0.30	0.80
4/13/83	432	60	9	0.07	0.04	0.30	0.12	0.61	0.70	1.00
5/7/80	40	110	50	0.04	0.03	0.36	0.03	0.82	0.90	1.30
5/20/81	52	70	10	0.06	0.02	0.29	0.12	0.49	0.66	0.95
5/18/82	21	70	23	0.04	0.03	0.22	0.09	0.57	0.70	0.92
5/18/83	371	70	23	0.06	0.02	0.20	0.06	0.70	0.80	1.00
5/14/86	46	80	36	0.04	0.02	0.40	0.02	0.37	0.40	0.80

6/13/84	64	80	7	0.01	0.01	0.20	0.01	0.98	1.00	1.20
6/14/85	77	100	17	0.01	0.01	0.10	0.05	0.25	0.30	
7/17/80	59	110	50	0.08	0.02	0.56	0.01	0.93	0.96	1.50
7/15/81	65	80	20	0.06	0.01	0.34	0.10	0.50	0.70	1.00
7/21/82	63	80	15	0.03	0.02	0.31	0.08	1.30	1.40	1.70
7/13/83	62	70	15	0.05	0.02	0.30	0.05	0.43	0.50	0.80
7/11/84	70	80	3	0.01	0.02	0.20	0.01	0.17	0.20	0.40
7/25/85	59	60	12	0.01	0.01	0.10	0.03	0.28	0.30	
7/24/86	64	80	11	0.05	0.04	0.50	0.05	0.47	0.50	1.00
8/31/83	62	60	18	0.02	0.02	0.30	0.01	0.60	0.70	1.00
8/28/84	71	80	3	0.05	0.01	0.20	0.01	0.59	0.60	0.80
9/9/80	60	140	40	0.07	0.05	0.51	0.02	0.50	0.50	1.00
9/2/81	73	80	10	0.04	0.01	0.27	0.06	0.94	1.00	1.30
9/7/82	68	80	3	0.11	0.01	0.30	0.10	0.35	0.60	0.90
9/12/85	70	120	3	0.02	0.01	0.10	0.09	0.31	0.40	
9/24/86	60	80	15	0.04	0.01	0.50	0.03	0.58	0.60	1.10

STA 11 169 970 Coyote Creek - below Leroy Anderson dam - near Madrone CA

MONTHLY AND SEASONAL AVERAGES MONTHLY AND SEASONAL AVERAGES

PERIOD	FLOW (inst) (CFS)	DIS. BORON (ug/l B)	DIS. IRON (ug/l Fe)	TOTAL P (mg/l P)	DIS. ORTHO P (mg/l P)	NO2+NO3 (mg/l N)	DIS. AMMONIA (mg/l N)	TOTAL ORGANIC (mg/l N)	TOTAL ORG+NH3 (mg/l N)	TOTAL N (mg/l N)
ALL										
average	97	88	33	0.06	0.02	0.28	0.06	0.64	0.70	1.07
cov	1.84	0.21	1.83	1.47	0.60	0.53	0.85	0.64	0.60	0.46
NOV	24	90	29	0.03	0.01	0.29	0.13	0.82	0.96	1.25
JAN	83	95	21	0.07	0.02	0.22	0.06	0.62	0.61	0.96
FEB	75	95	42	0.14	0.03	0.26	0.07	0.97	1.01	1.37
MAR	182	85	86	0.08	0.02	0.29	0.04	0.52	0.58	0.95
APR	432	60	9	0.07	0.04	0.30	0.12	0.61	0.70	1.00
MAY	106	80	28	0.05	0.02	0.29	0.06	0.59	0.69	0.99
JUN	71	90	12	0.01	0.01	0.15	0.03	0.62	0.65	1.20
JULY	63	80	18	0.04	0.02	0.33	0.05	0.58	0.65	1.07
SEPT	67	97	12	0.06	0.02	0.31	0.05	0.55	0.62	1.02
NOV - APR	112	91	43	0.08	0.02	0.26	0.07	0.69	0.74	1.10
MAY - OCT	75	85	18	0.04	0.02	0.30	0.05	0.58	0.65	1.04

Station #11169970 - COYOTE CREEK BELOW LEROY ANDERSON DAM NEAR MADRONE CALIF.

DATE	Flow (cfs)	Zn Dissolved (µg/l)	Zn Sediment (µg/gm)	Pb Dissolved (µg/l)	Pb Sediment (µg/gm)	Cu Dissolved (µg/l)	Cu Sediment (µg/gm)	As Dissolved (µg/l)	As Sediment (µg/gm)
1/6/82	9	10	20	1	10	2	20	2	8
1/28/83	570	3	50	1	20	2	260	1	3
2/21/80	3	10	40	ND	40	2	20	1	10
2/9/85	9	9	80	1	70	1	50	1	9
2/14/86	7	20		1		3		1	
2/25/86		10		2		1		2	
3/28/81	19	20	30	4	10	3	20	1	12
8/31/83	62	41	40	1	20	2	20	1	8
8/28/84	71	6	60	1	10	1	30	1	
9/9/80	60	10	20	2	10	2	20	2	6
9/2/81	73	10	40	2	10	1	20	1	14
9/7/82	68	10	20	1	10	3	10	1	4
9/12/85	70	10	70	1	10	1	70	2	12
All									
Mean	85	13	43	2	20	2	49	1	9
CV	1.7	0.7	0.5	0.6	0.9	0.4	1.4	0.4	0.4
n	12	13	11	12	11	13	11	13	10
Winter									
Mean	103	12	44	2	30	2	74	1	8
CV	2.0	0.5	0.5	0.7	0.8	0.4	1.3	0.4	0.4
n	6	7	5	6	5	7	5	7	5
Summer									
Mean	67	15	42	1	12	2	28	1	9
CV	0.1	0.8	0.4	0.4	0.3	0.4	0.7	0.4	0.4
n	6	6	6	6	6	6	6	6	5

Station #11169970 - COYOTE CREEK BELOW LEROY ANDERSON DAM NEAR MADRONE CALIF.

DATE	Flow (cfs)	Fe Sediment (µg/gm)	Mn Dissolved (µg/l)	Mn Sediment (µg/gm)	Al Dissolved (µg/l)	Al Sediment (µg/gm)	Co Sediment (µg/gm)
1/6/82	9	8500	10	850	10	5000	20
1/28/83	570	9500	3	310	80	3900	10
2/21/80	3	9500	10	610	170	90	30
2/9/85	9	53000	6	1700	10	23000	40
2/14/86	7		100		10		
2/25/86			790		10		
3/28/81	19	10000	20	1700	10	4200	30
8/31/83	62	6000	11	240	10	2100	20
8/28/84	71	23000	9	1100	10	9800	30
9/9/80	60	8000	30	700	20	3000	20
9/2/81	73	19000	ND	1800	ND	4000	20
9/7/82	68	6500	10	1200	10	2600	20
9/12/85	70	28000	350	1900	10	14000	30
All							
Mean	85	16455	112	1101	30	6517	25
CV	1.7	0.8	2.0	0.5	1.5	1.0	0.3
n	12	11	12	11	12	11	11
Winter							
Mean	103	18100	134	1034	43	7238	26
CV	2.0	1.0	2.0	0.6	1.3	1.1	0.4
n	6	5	7	5	7	5	5
Summer							
Mean	67	15083	82	1157	12	5917	23
CV	0.1	0.6	1.6	0.5	0.3	0.8	0.2
n	6	6	5	6	5	6	6

Station #11169970 - COYOTE CREEK BELOW LEROY ANDERSON DAM NEAR MADRONE CALIF.

DATE	Flow (cfs)	CD Dissolved (µg/l)	Cd Sediment (µg/gm)	Cr Dissolved (µg/l)	Cr Sediment (µg/gm)	Hg Dissolved (µg/l)	Hg Sediment (µg/gm)	Ni Sediment (µg/gm)	Se Dissolved (µg/l)	Se Sediment (µg/gm)
1/6/82	9	<1	<1	<10	20	<0.1	0.07	<100	--	<1
1/28/83	570	<1	1	<10	30	<0.1	0.11	<100	--	<1
2/21/80	3	0	0	0	30	0.00	0.13	0	--	0
2/9/85	9	<1	<1	<10	130	<0.1	0.07	<100	<1	<1
2/14/86	7	1	--	<10	--	<0.1	--	<100	--	--
2/25/86	- -	<1	--	<10	--	--	--	<100	--	--
3/28/81	19	0	0	10	34	0.00	0.60	0	--	0
8/31/83	62	<1	<1	<10	20	<0.1	0.06	<100	--	<1
8/28/84	71	<1	<1	<10	70	<0.1	0.65	<100	--	<1
9/9/80	60	0	2	0	13	0.00	0.04	0	--	0
9/2/81	73	0	<1	0	60	1.90	0.04	0	--	0
9/7/82	68	<1	<1	<10	20	<0.1	0.06	<100	--	<1
9/12/85	70	2	<1	<10	950	<0.1	0.08	<100	--	<1

Station #11169970 - COYOTE C BL LEROY ANDERSON DM NR MADRONE CALIF

DATE	Total Diazinon (µg/l)	Total 2,4-D, (µg/l)	Total Lindane (µg/l)	Total Malathion (µg/l)	Total Chlordane (µg/l)	Total DDD (µg/l)	Total DDE (µg/l)	Total DDT (µg/l)	Total Dieldrin (µg/l)	Total Heptachlor (µg/l)
2/21/80	0	0	0	0	0	0	0	0	0	0
9/9/80	0	0	0	0	0	0	0	0	0	0
3/28/81	0	0	0	0	0	0	0	0	0	0
9/2/81	0	--	0	0.01	0	0	0	0	0	0
1/6/82	<0.01	0.02	0	<0.01	0	0	0	0	0	0
9/7/82	<0.01	<0.01	<0.010	<0.01	<0.1	<0.010	<0.010	<0.010	<0.010	<0.010
1/28/83	<0.01	0.01	<0.020	<0.01	<0.2	<0.020	<0.020	<0.020	<0.020	<0.020
4/13/83	<0.01	0.02	<0.010	<0.01	<0.1	<0.010	<0.010	<0.010	<0.010	<0.010
8/31/83	<0.01	0.01	<0.010	<0.01	<0.1	<0.010	<0.010	<0.010	<0.010	<0.010
8/28/84	<0.01	<0.01	<0.010	<0.01	<0.1	<0.010	<0.010	<0.010	<0.010	<0.010
2/9/85	<0.01	0.01	<0.010	<0.01	<0.1	<0.010	<0.010	<0.010	<0.010	<0.010
9/12/85	<0.01	<0.01	<0.010	<0.01	<0.1	<0.010	<0.010	<0.010	<0.010	<0.010
1/30/86	<0.01	<0.01	<0.010	<0.01	<0.1	<0.010	<0.010	<0.010	<0.010	<0.010

Station #11169970 - COYOTE C BL LEROY ANDERSON DM NR MADRONE CALIF

DATE	Total Naphthalenes Polychlor (µg/l)	Total PCB (µg/l)	Total Aldrin (µg/l)	Total Endosulfan (µg/l)	Total Endrin (µg/l)	Total Ethion (µg/l)	Total Chlor Epoxide (µg/l)	Total Oxychlor (µg/l)	Total ethyl Parathio (µg/l)	Total ethyl Trithion (µg/l)
2/21/80	0	0	0	0	0	0	0	0	0	0
9/9/80	0	0	0	0	0	0	0	0	0	0
3/28/81	0	0	0	0	0	0	0	0	0	0
9/2/81	0	0	0	0	0	0	0	0	0	0
1/6/82	0	0	0	0	0	0	0	0	0	0
9/7/82	<0.10	<0.1	<0.010	<0.010	<0.010	<0.01	<0.010	<0.01	<0.01	<0.01
1/28/83	<0.20	<0.2	<0.020	<0.020	<0.020	<0.01	<0.020	<0.02	<0.01	<0.01
4/13/83	<0.10	<0.1	<0.010	<0.010	<0.010	<0.01	<0.010	<0.01	<0.01	<0.01
8/31/83	<0.10	<0.1	<0.010	<0.010	<0.010	<0.01	<0.010	<0.01	<0.01	<0.01
8/28/84	<0.10	<0.1	<0.010	<0.010	<0.010	<0.01	<0.010	<0.01	<0.01	<0.01
2/9/85	<0.10	<0.1	<0.010	<0.010	<0.010	<0.01	<0.010	<0.01	<0.01	<0.01
9/12/85	<0.10	<0.1	<0.010	<0.010	<0.010	<0.01	<0.010	<0.01	<0.01	<0.01
1/30/86	<0.10	<0.1	<0.010	<0.010	<0.010	<0.01	<0.010	<0.01	<0.01	<0.01

Station #11169970 - COYOTE C BL LEROY ANDERSON DM NR MADRONE CALIF

DATE	Total Mirex (µg/l)	Total Perthane (µg/l)	Total Toxaphene (µg/l)	Total Trithion (µg/l)	Total 2,4,5-T (µg/l)	Total Silvex (µg/l)
2/21/80	0	0	0	0	0	0
9/9/80	0	0	0	0	0	0
3/28/81	0	0	0	0	0	0
9/2/81	0	0	0	0	--	--
1/6/82	0	0	0	0	0	0
9/7/82	<0.01	<0.1	<1	<0.01	<0.01	<0.01
1/28/83	<0.02	<0.2	<2	<0.01	<0.01	<0.01
4/13/83	<0.01	<0.1	<1	<0.01	<0.01	<0.01
8/31/83	<0.01	<0.1	<1	<0.01	<0.01	<0.01
8/28/84	<0.01	<0.1	<1	<0.01	<0.01	<0.01
2/9/85	<0.01	<0.1	<1	<0.01	<0.01	<0.01
9/12/85	<0.01	<0.1	<1	<0.01	<0.01	<0.01
1/30/86	<0.01	<0.1	<1	<0.01	<0.01	<0.01

8720115A-F CON-7

USGS STATION NO. 11167572
GUADALUPE RIVER AT
ALAMITOS RECHARGE FACILITY AT SAN JOSE, CA

Station #11167572 GUADALUPE RIVER AT ALAMITOS RECHARGE FACILITY AT SAN JOSE CALIF.

Period	Flow (cfs)	Cond (µmohs)	TDS (mg/l)	pH	Temp (deg C)	Turbidity (NTU)	DO (mg/l)	DO (% sat)	Dis. Organic C (mg/l as C)	TH (mg/l as CaCO3)	Alkalinity (mg/l as CaCO3)
01/18/1979	18.0	439	250	8.2	10.5	-	9.2			200	160
01/11/1980	-	477	270			30.0				220	170
01/29/1981	-	326	180			200.0				140	
01/04/1982	-	215	130			190.0				100	
01/20/1982	-	481	270			3.5				230	
01/18/1983	-	485	270			44.0				220	
01/26/1983	-	196	120			480.0				93	
01/15/1985	14.0	462	260	7.9	10.0	3.0	11.7	104	3.3	180	141
01/29/1985	7.2	466	270	8.3	11.0	2.3	13.0	118	3.0	180	137
01/29/1986	3.6	630	370	8.5	12.0	1.7	11.6	109		300	239
02/14/1979	68.0	415	240	7.8	13.5	-	10.7			170	130
02/18/1980	-	266	160			220.0				120	99
02/16/1982	-	391	210			46.0				190	
02/07/1983	-		180			100.0				140	
02/28/1983	-		130			190.0				98	
02/27/1984	-		320			-				260	
02/09/1985	40.0	428	240	7.9	10.0	39.0	9.4	83		180	134
02/13/1986	74.0	450		8.1	13.0	39.0	10.0	95		210	169
02/25/1986	247.0		200	8.0		40.0	10.2			170	133
03/16/1979	12.0	504	300	8.4	14.5	-	12.2			230	190
03/27/1979	86.0	372	220	7.9	14.5	-	9.3			180	140
03/05/1980	-	363	210			39.0				170	150
03/04/1981	-	512	290			16.0				220	
03/26/1981	-	498	280			54.0				200	
03/29/1982	-	355	210			32.0				180	
03/17/1984	13.0	530	300	8.4	16.0	2.0	9.4	94	3.0	250	
03/11/1985	14.0	477	270	8.0	13.0	12.0	9.6	91		210	160
03/11/1986	512.0	278	170	8.2	14.0	61.0	10.3	100		130	121
04/11/1983	-		300			20.0				250	
04/26/1979	15.0	557	330	8.2	18.0	-	9.7			280	220
05/23/1979	18.0	463	290	8.3	23.0	-	11.1			250	210
05/06/1980	-	451	280			18.0				240	200
05/18/1981	-	494	280			10.0				230	
05/17/1982	-	564	310			5.0				260	
05/16/1983	-	467	270			78.0				220	
05/13/1986	15.0	514	300	8.4	21.5	5.5	10.6	121		240	208
06/11/1984	-		300			7.3				250	218

06/13/1985	11.0	583	340	8.4	25.0	1.5	9.8	120		290	240
07/31/1979	13.0	475	280	8.4	25.5	-	12.2			230	210
07/16/1980	-	493	280			1.3				220	200
07/13/1981	-	638	310			11.0				260	
07/19/1982	-	518	300			13.0				260	
07/12/1983	11.0	502	280	8.6	23.5	2.0	9.9	118	1.9	230	200
07/10/1984	17.0	495	290	8.6	26.0	4.4	10.1	126		250	215
07/22/1986	7.9	517	300	8.6	25.5	1.0	8.3	102		230	215
08/31/1981	-	439	240			-				210	
08/29/1983	-	527	300			15.0				260	
08/27/1984	1.8	550	310	8.0	23.0	1.1	6.9	81	3.9	260	234
09/04/1979	13.0	433	250	8.6	24.5	-	12.1			220	190
09/10/1980	-		330			12.0				270	220
09/07/1982	-	480	270			7.4				220	
09/11/1985	5.8	612	360	8.4	21.5	1.3	10.7	122		290	244
09/23/1986	13.0	456	270	8.2	20.0	1.5	9.3	103		220	190
11/20/1979	10.0	470	290	8.4	16.5	2.2	11.6		3.9	210	180
11/18/1980	-	448	250			18.0				210	
11/16/1981	-	429	240			42.0				190	
11/15/1982	-	509	290			15.0				240	
12/30/1981	25.0	551	320	7.8	13.5	7.8	8.6	83	3.8	250	204

Station #11167572 GUADALUPE RIVER AT ALAMITOS RECHARGE FACILITY AT SAN JOSE CALIF.

Period	Flow (cfs)	Cond (µmohs)	TDS (mg/l)	pH	Temp (deg C)	Turbidity (NTU)	DO (mg/l)	DO (% sat)	Dis. Organic C (mg/l as C)	TH (mg/l as CaCO3)	Alkalinity (mg/l as CaCO3)
All											
Mean	47.6	464	265	8.2	17.7	44.7	10.3	104	3.3	214	184
CV	2.20	0.20	0.21	0.03	0.32	1.89	0.13	0.14	0.22	0.22	0.21
n	27	51	57	27	26	48	27	17	7	58	33
Month											
Nov	10.0	464	268	8.4	16.5	19.3	11.6		3.9	213	180
Jan	13.6	430	246	8.1	11.4	96.2	10.8	104	3.4	192	175
Feb	107.3	390	210	8.0	12.2	96.3	10.1	89		171	133
Mar	127.4	432	255	8.2	14.4	29.5	10.2	95	3.0	202	152
May	14.8	512	300	8.3	21.9	17.9	10.3	121		251	216
July	12.2	520	291	8.6	25.1	5.5	10.1	115	1.9	240	208
Sept	8.4	500	291	8.3	22.3	6.4	9.8	102	3.9	244	216
Winter											
Nov-Apr	76.3	428	243	8.1	13.0	67.2	10.5	97	3.4	192	156
n	15	29	33	15	14	29	15	9	5	34	17
Summer											
May-Sept	11.8	510	295	8.4	23.1	10.3	10.1	112	2.9	245	213
n	12	22	24	12	12	19	12	8	2	24	16

Station #11167572 GUADALUPE RIVER AT ALAMITOS RECHARGE FACILITY AT SAN JOSE CALIF.

Period	Flow (cfs)	Total Phosphorous (mg/l as P)	Ortho P (mg/l as P)	Total Boron (mg/l as B)	Dis Iron (mg/l as Fe)	Nitrogen NO3+NO2 (mg/l as N)	Dis. Ammonia (mg/l as N)	Total Organic (mg/l as N)	Total ORG+NH3 (mg/l as N)	Total Nitrogen (mg/l as N)
01/18/1979	18	0.18	0.08	110	10	1.90	0.06	0.74	0.84	2.70
01/11/1980		0.15	0.11	120	60	1.60	0.04	1.10	1.10	2.70
01/29/1981		0.27	0.16	80	80	1.80	0.15			
01/04/1982		0.28	0.20	60	240	1.60	0.11	1.10	1.20	2.80
01/20/1982		0.10	0.09	100	46	2.60	0.21	0.53	0.76	3.40
01/18/1983		0.16	0.08	100	16	2.20	0.12	1.00	1.10	3.30
01/26/1983		0.33	0.10	50	150	0.63	0.08	1.30	1.60	2.20
01/15/1985	14	0.05	0.04	130	16	1.60	0.06	0.64	0.70	2.40
01/29/1985	7.2	0.04	0.02	130	12	1.50	0.04	0.48	0.50	2.10
01/29/1986	3.6	0.03	0.01	140	8		0.05	0.63	0.70	2.30
02/14/1979	68	0.11	0.04	160	60	1.40	0.02	0.63	0.72	2.10
02/18/1980		0.57	0.16	110	30	1.30	0.10	1.50	1.70	3.00
02/16/1982		0.07	0.04	80	13	1.20	0.11	0.59	0.71	1.70
02/07/1983		0.20	0.09	70	92	0.74	0.13	0.80	0.90	1.70
02/28/1983		0.25	0.09	50	160	0.45	0.14	1.30	1.50	2.00
02/27/1984		0.15	0.01	130	3	1.80	0.04	1.40	1.40	3.10
02/09/1985	40	0.13	0.04	110	37	0.87	0.04	1.20	1.30	3.00
02/13/1986	74	0.14	0.06	100	63		0.11	0.71	0.80	2.20
02/25/1986	247	0.06	0.03	80	43		0.04	0.36	0.40	2.00
03/16/1979	12	0.04	0.01	150	10	1.70	0.01	0.46	0.51	2.10
03/27/1979	86	0.11	0.03	130	30	1.10	0.06	0.45	0.51	1.50
03/05/1980		0.09	0.08	90	30	1.10	0.07	0.75	0.82	1.90
03/04/1981		0.13	0.02	130	20	2.30	0.04	1.20	1.30	3.40
03/26/1981		0.18	0.00	130	20	1.30	0.05	1.70	1.80	3.10
03/29/1982		0.05	0.05	100	10	1.10	0.10	0.54	0.68	1.80
03/17/1984	13	0.02	0.05	110	3	1.70	0.08	0.36	0.40	2.10
03/11/1985	14	0.07	0.05	120	34	1.60	0.06	0.41	0.50	2.10
03/11/1986	512	0.11	0.04	70	96		0.03	0.43	0.50	1.10
04/11/1983		0.06	0.03	110	3	1.80	0.10	1.50	1.60	3.40
04/26/1979	15	0.04	0.02	160	10	1.90	0.01	0.47	0.53	2.40
05/23/1979	18	0.03	0.01	130	10	0.83	0.01	0.32	0.40	1.30
05/06/1980		0.05	0.00	110	10	1.40	0.04	0.98	1.10	
05/18/1981		0.08	0.01	100	10	1.00	0.11	1.50	1.70	2.70
05/17/1982		0.05	0.02	110	9	2.10	0.10	0.85	0.98	3.00
05/16/1983		0.05	0.01	110	6	1.10	0.07	0.39	0.50	1.60
05/13/1986	15	0.03	0.01	130	3		0.02	0.39	0.40	1.70
06/11/1984		0.04	0.01	180	13	0.60	0.04	0.77	0.80	1.40

06/13/1985	11	0.01	0.01	150	8	0.66	0.04	0.43	0.50	1.10
07/31/1979	13	0.01	0.01	130	10	0.64	0.04	0.37	0.38	1.00
07/16/1980		0.03	0.00	140	10	1.30	0.04	0.60	0.64	1.90
07/13/1981		0.08	0.02	120	10	0.78	0.12	1.00	1.20	2.00
07/19/1982		0.02	0.01	130	3	1.30	0.07	3.00	3.10	4.40
07/12/1983	11	0.02	0.01	140	6	0.90	0.04	0.76	0.80	1.70
07/10/1984	17	0.01	0.02	160	4	0.51	0.01	0.45	0.50	1.00
07/22/1986	7.9	0.02	0.01	130	7		0.02	0.37	0.40	1.10
08/31/1981		0.04	0.00	120	10	0.35		0.90	1.00	1.30
08/29/1983		0.05	0.01	130	3	0.92	0.03	1.00	1.10	2.00
08/27/1984	1.8	0.01	0.01	130	7	0.25	0.01	0.38	0.40	0.70
09/04/1979	13	0.02	0.01	140	10	0.29	0.03	0.55	0.58	0.87
09/10/1980		0.07	0.01	150	20	1.50	0.01	0.68	0.71	2.30
09/07/1982		0.04	0.01	120	6	0.82	0.14	0.69	0.90	1.70
09/11/1985	5.8	0.02	0.01	140	9	0.47	0.06	0.44	0.50	1.00
09/23/1986	13	0.02	0.01	130	5		0.05	0.34	0.40	1.00
11/20/1979	10	0.00	0.01	150	10	0.69	0.05	0.34	0.43	1.10
11/18/1980		0.03	0.01	130	10	0.84	0.05	0.49	0.54	1.40
11/16/1981		0.15	0.12	100	56	1.50	0.21	0.64	0.82	2.30
11/15/1982		0.05	0.01	140	4	0.97	0.15	1.50	1.60	2.60
12/30/1981	25	0.08	0.04	130	12	1.90	0.07	1.20	1.30	3.10

Station #11167572 GUADALUPE RIVER AT ALAMITOS RECHARGE FACILITY AT SAN JOSE CALIF.

Period	Flow (cfs)	Phosphorous (mg/l as P)	Ortho P (mg/l as P)	Total Boron (mg/l as B)	Dis Iron (mg/l as Fe)	Nitrogen NO3+NO2 (mg/l as N)	Dis. Ammonia (mg/l as N)	Total Organic (mg/l as N)	Total ORG+NH3 (mg/l as N)	Total Nitrogen (mg/l as N)
All										
Mean	47.6	0.09	0.04	119	29	1.22	0.07	0.80	0.89	2.09
CV	2.20	1.08	1.14	0.23	1.50	0.46	0.70	0.60	0.57	0.39
n	27	58	58	58	58	51	57	57	57	56
Month										
Nov	10.0	0.06	0.04	130	20	1.00	0.12	0.74	0.85	1.85
Jan	13.6	0.15	0.08	105	59	1.73	0.09	0.87	0.98	2.70
Feb	107.3	0.19	0.06	99	56	1.11	0.08	0.94	1.05	2.31
Mar	127.4	0.09	0.04	114	26	1.52	0.06	0.78	0.86	2.25
May	14.8	0.04	0.01	131	9	1.20	0.05	0.68	0.77	1.90
July	12.2	0.03	0.01	136	7	0.91	0.05	0.94	1.00	1.87
Sept	8.4	0.03	0.01	133	9	0.66	0.05	0.62	0.70	1.36
Winter										
Nov-Apr	76.3	0.13	0.06	109	44	1.43	0.08	0.85	0.95	2.35
n	15	34	34	34	34	30	34	33	33	33
Summer										
May-Sept	11.8	0.04	0.01	133	8	0.93	0.05	0.73	0.81	1.70
n	12	24	24	24	24	21	23	24	24	23

Station #11167572 GUADALUPE RIVER AT ALAMITOS RECHARGE FACILITY AT SAN JOSE CALIF.

DATE	Flow (cfs)	Zn dissolved (µg/l)	Zn sediment (µg/l)	PB dissolved (µg/l)	PB sediment (µg/l)	Cu dissolved (µg/l)	Cu sediment (µg/l)	As dissolved (µg/l)	As sediment (µg/l)
01/04/1982		20		4		6		2	
01/18/1979		3		4		3		2	
01/26/1983		3	30	1	10	4	20	1	9
02/09/1985	40	3	140	1	110	4	60	1	6
02/13/1986	74	14		2		1		1	
02/18/1980		50		3		3		1	
02/25/1986	247	10		3		1		1	
02/27/1984				1		2		1	
03/26/1981		80		3		4		2	
07/31/1979	13	3		ND		ND		1	
08/27/1984	1.8	30	50	1	10	1	30	1	1
08/29/1983		43		1		3		1	
08/31/1981		80		5		3		1	
09/07/1982		76		1		6		2	
09/10/1980		50		4		ND		2	
09/11/1985	6	10	90	1	10	1	70	1	9
All Data									
Mean	64	32	78	2	35	3	45	1	6
CV	1.48	0.93	0.63	0.62	1.43	0.57	0.53	0.36	0.60
n	6	15	4	15	4	14	4	16	4
Winter									
Mean	120	23	85	2	60	3	40	1	8
CV	0.92	1.22	0.92	0.51	1.18	0.52	0.71	0.38	0.28
n	3	8	2	9	2	9	2	9	2
Summer									
Mean	7	42	70	2	10	3	50	1	5
CV	0.83	0.72	0.40	0.85	0.00	0.73	0.57	0.38	1.13
n	3	7	2	6	2	5	2	7	2

Station #11167572 GUADALUPE RIVER AT ALAMITOS RECHARGE FACILITY AT SAN JOSE CALIF.

DATE	Flow (cfs)	Fe sediment (µg/l)	Mn dissolved (µg/l)	Mn sediment (µg/l)	Al dissolved (µg/l)	Al sediment (µg/l)	Co sediment (µg/l)
01/04/1982			20		20		
01/18/1979			8		10		
01/26/1983		11000	4	330	120	6400	20
02/09/1985	40	36000	15	2100	40	20000	30
02/13/1986	74		17		30		
02/18/1980			20		50		
02/25/1986	247		10		20		
02/27/1984							
03/26/1981			5		20		
07/31/1979	13		3		100		
08/27/1984	1.8	19000	8	360	10	9000	20
08/29/1983			2		10		
08/31/1981			ND		10		
09/07/1982			2		10		
09/10/1980			10		0		
09/11/1985	6	21000	10	630	10	12000	30
All Data							
Mean	64	21750	10	855	31	11850	25
CV	1.48	0.48	0.66	0.98	1.14	0.50	0.23
n	6	4	14	4	15	4	4
Winter							
Mean	120	23500	12	1215	39	13200	25
CV	0.92	0.75	0.52	1.03	0.91	0.73	0.28
n	3	2	8	2	8	2	2
Summer							
Mean	7	20000	6	495	21	10500	25
CV	0.83	0.07	0.67	0.39	1.63	0.20	0.28
n	3	2	6	2	7	2	2

Station #11167572 GUADALUPE RIVER AT ALAMITOS RECHARGE FACILITY AT SAN JOSE CALIF.

DATE	Flow (cfs)	Cd dissolved (µg/l)	Cd sediment (µg/l)	Cr dissolved (µg/l)	Cr sediment (µg/l)	Hg dissolved (µg/l)	Hg sediment (µg/l)	Ni sediment (µg/l)	Se dissolved (µg/l)	Se sediment (µg/l)
01/04/1982		<1		<10		<0.1				
01/18/1979		<2		<20		<0.1		<200		
01/26/1983		<1	<1	<10	40	<0.1	4	<100		<1
02/09/1985	40	<1	<1	<10	100	<0.1	0	<100	<1	<1
02/13/1986	74	<1		<10		<0.1		<100		
02/18/1980		0		0		0		0		
02/25/1986	247	<1		<10		<0.1		<100		
02/27/1984		<1		<10		<0.1				
03/26/1981		2		10		0		100		
07/31/1979	13	<2		ND		<0.1		ND		
08/27/1984	1.8	<1	<1	10	80	<0.1	2	<100		<1
08/29/1983		<1		10		<0.1		<100		
08/31/1981		1		0		0		0		
09/07/1982		<1		10		<0.1		<100		
09/10/1980		1		0		0		0		
09/11/1985	6	<1	<1		1100	<0.1	4	<100		<1

STATION #11167572 GUADALUPE RIVER AT ALAMITOS RECHARGE FACILITY AT SAN JOSE CALIF.

DATE	Total Diazinon (μg/l)	Total 2,4-D, (μg/l)	Total Lindane (μg/l)	Total Malathion (μg/l)	Total Chlordane (μg/l)	Total DDD (μg/l)	Total DDE (μg/l)	Total DDT (μg/l)	Total Dieldrin (μg/l)	Total Heptachlor (μg/l)
01/05/1982	0.05	0.03	0.01	0.09	0	0.01	0.01	0	0	0
01/26/1983	0.01	0.01	<0.010	<0.01	<0.1	<0.010	0.01	<0.010	0.01	<0.010
01/29/1986	0.11	0.04	<0.010	<0.01	<0.1	<0.010	<0.010	<0.010	<0.010	<0.010
02/09/1985	0.12	0.03	0.03	0.01	<0.1	<0.010	<0.010	<0.010	<0.010	<0.010
02/13/1986	0.1	0.17	<0.010	0.01	<0.1	<0.010	<0.010	<0.010	<0.010	<0.010
02/19/1980	0.03	0	0	0	0.1	0	0	0	0	0
02/25/1986	<0.01	<0.01	<0.010	<0.01	<0.1	<0.010	<0.010	<0.010	<0.010	<0.010
03/27/1981	0.03	0.06	0.01	0	0	0	0	0	0	0
04/12/1983	0.01	0.02	<0.010	<0.01	<0.1	<0.010	<0.010	<0.010	<0.010	<0.010
07/22/1986	0.02	0.02	<0.010	<0.01	<0.1	<0.010	<0.010	<0.010	<0.010	<0.010
08/27/1984	0.01	0.03	<0.010	<0.01	<0.1	<0.010	<0.010	<0.010	<0.010	<0.010
08/30/1983	0.01	0.01	<0.010	<0.01	<0.1	<0.010	<0.010	<0.010	<0.010	<0.010
09/01/1981	0.01	0.02	0	0.16	0	0	0	0	0	0
09/08/1982	0.01	<0.01	<0.010	<0.01	<0.1	<0.010	<0.010	<0.010	<0.010	<0.010
09/10/1980	0	0	0	0	0	0	0	0	0	0
09/11/1985	0.01	0.03	<0.010	<0.01	<0.1	<0.010	<0.010	<0.010	<0.010	<0.010
09/23/1986	0.01	0.01	<0.010	<0.01	<0.1	<0.010	<0.010	<0.010	<0.010	<0.010

STATION #11167572 GUADALUPE RIVER AT ALAMITOS RECHARGE FACILITY AT SAN JOSE CALIF.

DATE	Naphthalenes Polychlor (µg/l)	Total PCB (µg/l)	Total Aldrin (µg/l)	Total Endosulfan (µg/l)	Total Endrin (µg/l)	Total Ethion (µg/l)	Total Chlor Epoxide (µg/l)	Total Oxychlor (µg/l)	Total Methyl Parathion (µg/l)
01/05/1982	0	0	0	0	0	0	0	0	0
01/26/1983	<0.10	<0.1	<0.010	<0.010	<0.010	<0.01	<0.010	<0.01	<0.01
01/29/1986	<0.10	<0.1	<0.010	<0.010	<0.010	<0.01	<0.010	<0.01	<0.01
02/09/1985	<0.10	<0.1	<0.010	<0.010	<0.010	<0.01	<0.010	<0.01	<0.01
02/13/1986	<0.10	<0.1	<0.010	<0.010	<0.010	<0.01	<0.010	<0.01	<0.01
02/19/1980	0	0	0	0	0	0	0	0	0
02/25/1986	<0.10	<0.1	<0.010	<0.010	<0.010	<0.01	<0.010	<0.01	<0.01
03/27/1981	0	0	0	0	0	0	0	0	0
04/12/1983	<0.10	<0.1	<0.010	<0.010	<0.010	<0.01	<0.010	<0.01	<0.01
07/22/1986	<0.10	<0.1	<0.010	<0.010	<0.010	<0.01	<0.010	<0.01	<0.01
08/27/1984	<0.10	<0.1	<0.010	<0.010	<0.010	<0.01	<0.010	<0.01	<0.01
08/30/1983	<0.10	<0.1	<0.010	<0.010	<0.010	<0.01	<0.010	<0.01	<0.01
09/01/1981	0	0	0	0	0	0	0	0	0
09/08/1982	<0.10	<0.1	<0.010	<0.010	<0.010	<0.01	<0.010	<0.01	<0.01
09/10/1980	0	0	0	0	0	0	0	0	0
09/11/1985	<0.10	<0.1	<0.010	<0.010	<0.010	<0.01	<0.010	<0.01	<0.01
09/23/1986	<0.10	<0.1	<0.010	<0.010	<0.010	<0.01	<0.010	<0.01	<0.01

STATION #11167572 GUADALUPE RIVER AT ALAMITOS RECHARGE FACILITY AT SAN JOSE CALIF.

DATE	Total Methyl Trithion (µg/l)	Total Mirex (µg/l)	Total Perthane (µg/l)	Total Toxaphene (µg/l)	Total Trithion (µg/l)	Total 2,4,5-T (µg/l)	Total Silvex (µg/l)
01/05/1982	0	0	0	0	0	0	0
01/26/1983	<0.01	<0.01	<0.1	<1	<0.01	<0.01	<0.01
01/29/1986	<0.01	<0.01	<0.1	<1	<0.01	<0.01	<0.01
02/09/1985	<0.01	<0.01	<0.1	<1	<0.01	<0.01	<0.01
02/13/1986	<0.01	<0.01	<0.1	<1	<0.01	<0.01	<0.01
02/19/1980	0	0	0	0	0	0	0
02/25/1986	<0.01	<0.01	<0.1	<1	<0.01	<0.01	<0.01
03/27/1981	0	0	0	0	0	0	0
04/12/1983	<0.01	<0.01	<0.1	<1	<0.01	<0.01	<0.01
07/22/1986	<0.01	<0.01	<0.1	<1	<0.01	<0.01	<0.01
08/27/1984	<0.01	<0.01	<0.1	<1	<0.01	<0.01	<0.01
08/30/1983	<0.01	<0.01	<0.1	<1	<0.01	<0.01	<0.01
09/01/1981	0	0	0	0	0	0	0
09/08/1982	<0.01	<0.01	<0.1	<1	<0.01	<0.01	<0.01
09/10/1980	0	0	0	0	0	0	0
09/11/1985	<0.01	<0.01	<0.1	<1	<0.01	<0.01	<0.01
09/23/1986	<0.01	<0.01	<0.1	<1	<0.01	<0.01	<0.01

8720115A-F CON-8

USGS STATION NO. 11169000
GUADALUPE RIVER AT
SAN JOSE, CA

STATION #11169000 GAUDALUPE RIVER AT SAN JOSE, CALIF.

Period	Flow (cfs)	Cond (µmohs)	TDS (mg/l)	pH	Temp (deg C)	Turbidity (NTU)	DO (mg/l)	DO (% sat)	Dis. Organic C (mg/l as C)	TH (mg/l as CaCO3)	Alkalinity (mg/l as CaCO3)
1/17/79	52.0	405	230	7.6	9.0	--	11.0	--	5.1	180	140
1/12/80	221.0	300	180	7.4	15.0	28	9.1	--	--	130	97
1/29/81	293.0	282	150	7.4	11.0	130	10.2	93	--	110	90
1/5/82	943.0	242	140	7.9	11.0	270	10.5	95	--	110	100
1/21/82	137.0	369	210	8.0	9.0	6	11.0	95	--	170	144
1/19/83	68.0	454	260	8.1	10.0	27	10.7	95	--	200	170
1/27/83	1540.0	235	150	7.9	12.0	350	10.6	99	--	99	104
1/29/85	22.0	681	410	8.3	13.5	6.5	10.8	103	42.0	320	269
1/29/86	25.0	652	400	8.3	15.0	28	8.8	88	10.0	310	266
1/28/87	24.0	393	246	8.1	13.0	17	9.7	92	5.1	180	147
1/15/85	23.0	715	440	8.5	13.0	1.4	11.6	110	5.0	350	302
2/14/79	135.0	177	140	7.2	12.5	--	10.0	--	--	95	67
2/19/80	7900.0	172	100	6.8	12.5	800	9.7	--	--	68	62
2/17/82	348.0	362	200	8.6	12.0	50	10.0	92	--	170	160
2/8/83	934.0	270	150	8.0	12.0	150	10.7	100	--	120	84
2/28/84	28.0	695	200	8.6	15.0	5.7	12.0	120	18.0	310	128
2/9/85	116.0	496	290	8.2	10.0	30	10.8	95	30.0	220	178
2/13/86	124.0	466	280	8.3	14.0	81	10.0	97	42.0	220	171
2/24/86	925.0	202	150	8.2	11.0	330	11.1	100	98.0	110	94
2/11/87	31.0	605	362	8.4	16.0	6.8	11.4	116	3.3	270	230
3/16/79	27.0	288	160	7.7	13.5	--	8.5	--	--	100	71
3/27/79	453.0	176	100	7.5	13.5	--	9.5	--	--	73	52
3/6/80	302.0	336	190	7.8	13.0	57	10.0	--	--	150	130
3/5/81	21.0	394	230	7.7	12.0	19	10.0	94	--	160	120
3/27/81	3.7	332	190	8.0	15.5	16	8.4	84	--	130	120
3/30/82	480.0	323	190	8.1	11.0	48	10.4	94	--	150	122
3/1/83	4240.0	200	130	8.0	13.0	330	10.0	--	--	93	88
3/17/84	29.0	350	440	7.9	15.0	54	8.8	86	3.0	140	289
3/11/85	69.0	252	150	8.0	14.5	23	8.8	86	40.0	110	92
3/11/86	1480.0	258	150	8.2	13.5	110	10.2	98	39.0	110	100
3/5/87	200.0	342	198	7.9	14.0	24	9.3	91	12.0	140	117
4/12/83	61.0	554	250	9.0	14.0	15	13.1	128	16.0	250	170
4/26/79	31.0	259	150	7.2	18.5	--	6.8	--	19.0	88	62
5/23/79	0.7	895	520	8.1	18.5	--	7.8	--	--	360	290
5/6/80	0.7	826	490	8.2	16.5	5.2	7.4	76	--	370	310
5/19/81	0.5	866	510	8.1	16.0	2.1	6.3	64	--	370	340
5/18/82	3.7	918	570	8.3	17.5	0.5	12.1	127	--	430	384
5/17/83	103.0	411	420	8.5	18.0	6.5	10.0	105	6.0	190	270

5/13/86	25.0	690	430	8.4	20.0	4	10.5	116	<3	320	272
6/12/84	24.0	817	420	8.5	20.0	1.1	11.8	131	5.0	340	283
6/13/85	20.0	736	450	8.4	22.0	4	8.9	102	4.0	350	295
6/2/87	20.0	712	461	8.4	22.0	4.5	10.4	119	- -	340	294
7/16/80	0.2	750	440	8.3	21.5	6.9	15.6	176	--	320	280
7/14/81	0.3	702	440	8.5	23.0	5.2	13.2	155	--	290	250
7/20/82	3.2	864	540	8.4	21.5	4.2	12.7	144	--	360	300
7/12/83	18.0	743	440	8.6	23.0	1	9.6	113	4.0	330	290
7/10/84	25.0	614	430	8.5	21.5	6.4	12.0	137	<3	320	283
7/24/85	22.0	748	430	8.0	22.0	23	10.9	127	6.0	340	288
7/22/86	22.0	765	460	8.4	21.5	8.6	11.5	131	4.0	340	310
7/7/87	17.0	722	450	8.4	23.0	32	8.7	102	2.8	340	305
8/1/79	0.3	735	460	8.2	26.0	--	10.9	--	15.0	310	270
8/30/83	20.0	713	400	8.3	23.0	4.5	10.6	124	11.0	350	277
8/27/84	22.0	721		8.3	21.0	16	9.7	109		330	
8/11/87	15.0	724	434	8.4	22.0	8	10.4	120	2.5	340	292
9/4/79	0.0	859	520	8.0	21.0	--	7.0	--	19.0	350	290
9/10/80	0.5	869	500	7.8	18.0	4	6.2	--	--	350	310
9/1/81	0.3	728	440	8.0	19.5	2.6	9.8	107	--	300	250
9/8/82	2.8	498	280	7.5	23.0	1.5	9.9	116	--	200	138
9/11/85	20.0	712	430	8.4	17.5	24	9.4	98	3.0	340	289
9/23/86	23.0	701	450	8.3	18.0	100	7.6	81	3.0	350	295
11/18/80	0.2	724	400	7.2	10.5	4.9	1.0	9	--	260	240
11/17/81	128.0	289	150	7.8	15.5	70	8.6	85	--	120	102
11/16/82	14.0	606	360	8.4	12.5	20	10.0	94	--	260	230
12/6/86	27.0	496	291	8.1	14.0	13	8.8	85	8.9	230	187
12/30/81	27.0	375	210	8.0	13.0	52	9.5	90	--	160	130

STATION #11169000 GAUDALUPE RIVER AT SAN JOSE, CALIF.

Period	Flow (cfs)	Cond (µmohs)	TDS (mg/l)	pH	Temp (deg C)	Turbidity (NTU)	DO (mg/l)	DO (% sat)	Dis. Organic C (mg/l as C)	TH (mg/l as CaCO3)	Alkalinity (mg/l as CaCO3)
All											
Mean	341.6	537	321	8.1	16.2	60.7	9.9	104	16.1	238	202
CV	3.32	0.42	0.44	0.05	0.27	2.16	0.20	0.24	1.25	0.43	0.45
n	64	64	63	64	64	56	64	51	30	64	63
Month											
Nov	42.3	529	300	7.9	13.1	27.0	7.1	68	8.9	218	190
Jan	281.3	425	252	8.0	12.0	83.3	10.3	96	13.4	193	163
Feb	1171.2	383	208	8.0	12.8	181.7	10.6	103	38.3	176	130
Mar	613.8	317	198	8.0	13.5	69.6	9.8	95	22.0	134	123
May	22.9	713	442	8.2	18.9	3.5	9.2	105	8.5	316	280
July	12.0	738	454	8.4	22.6	10.9	11.7	136	6.4	328	286
August	14.3	723	431	8.3	23.0	9.5	10.4	118	9.5	333	280
Sept	7.8	728	437	8.0	19.5	26.4	8.3	101	8.3	315	262
Winter											
Nov-Apr	579.8	391	229	8.0	12.8	96.2	9.9	94	23.6	172	145
n	37	37	37	37	37	33	37	29	16	37	37
Summer											
May-Sept	15.7	725	443	8.2	20.5	11.5	9.9	117	7.5	322	278
n	28	28	27	28	28	24	28	23	14	28	27

STATION #11169000 GAUDALUPE RIVER AT SAN JOSE, CALIF.

Period	Flow (cfs)	Total Phosphorous (mg/l as P)	Dis Ortho P (mg/l as P)	Boron (mg/l as B)	Iron (mg/l as Fe)	Nitrogen NO3+NO2 (mg/l as N)	Dis. Ammonia (mg/l as N)	Total Organic (mg/l as N)	Total Nitrogen (mg/l as N)
1/17/79	52.0	0.16	0.04	110	20	1.50	0.06	0.58	2.20
1/12/80	221.0	0.23	0.09	100	80	0.99	0.06	1.20	2.30
1/29/81	293.0	0.26	0.15	60	30	1.50	0.10	--	--
1/5/82	943.0	0.25	0.16	60	150	1.80	0.13	1.20	3.20
1/21/82	137.0	0.15	0.12	80	22	1.70	0.15	0.61	2.60
1/19/83	68.0	0.47	0.31	100	17	1.90	0.07	0.93	2.90
1/27/83	1540.0	0.60	0.08	50	150	0.80	0.09	1.10	2.10
1/29/85	22.0	0.07	--	0.04	150	3.50	0.60	0.55	4.20
1/29/86	25.0	0.17	0.07	0.06	150	--	1.10	0.98	4.30
1/28/87	24.0	0.10	0.05	90	19	1.70	0.05	1.20	2.90
1/15/85	23.0	0.02	--	0.02	160	3.60	0.30	- -	4.10
2/14/79	135.0	0.17	0.07	80	80	0.76	0.13	0.81	1.60
2/19/80	7900.0	2.80	0.20	70	190	0.93	0.09	4.50	5.60
2/17/82	348.0	0.06	0.04	80	38	0.80	0.08	0.57	1.50
2/8/83	934.0	0.21	0.09	50	40	0.60	0.09	1.00	1.70
2/28/84	28.0	0.14	--	0.05	80	1.40	0.60	0.47	2.00
2/9/85	116.0	0.10	--	0.03	130	1.20	1.00	0.97	3.10
2/13/86	124.0	0.09	0.06	0.02	90	--	1.10	1.00	2.60
2/24/86	925.0	0.21	0.04	0.02	70	--	1.10	1.00	2.10
2/11/87	31.0	0.04	0.02	160	5	- -	0.01	0.70	2.70
3/16/79	27.0	0.27	0.13	130	30	1.30	0.06	1.40	2.60
3/27/79	453.0	0.67	0.13	70	100	0.63	--	1.50	2.20
3/6/80	302.0	0.10	0.05	80	30	0.56	0.04	0.83	1.70
3/5/81	21.0	0.15	0.06	120	50	1.40	0.06	1.00	2.50
3/27/81	3.7	0.21	0.05	80	20	0.81	0.08	1.20	2.00
3/30/82	480.0	0.08	0.05	80	34	0.56	0.12	0.42	1.10
3/1/83	4240.0	0.79	0.07	50	240	0.43	0.12	1.90	2.50
3/17/84	29.0	0.02	--	0.01	160	3.30	1.00	0.55	4.20
3/11/85	69.0	0.18	--	0.1	60	0.88	0.70	0.61	1.60
3/11/86	1480.0	0.17	0.05	0.04	50	--	0.60	0.52	1.30
3/5/87	200.0	0.20	0.09	100	41	- -	0.03	1.80	3.10
4/12/83	61.0	0.04	--	0.01	80	1.10	0.60	1.00	1.70
4/26/79	31.0	0.21	0.07	160	70	0.82	0.06	1.00	1.90
5/23/79	0.7	0.13	0.09	450	10	0.79	0.01	0.82	1.70
5/6/80	0.7	0.13	0.04	220	20	1.40	0.03	1.40	3.00
5/19/81	0.5	0.24	0.14	190	10	1.70	0.21	0.86	2.80
5/18/82	3.7	0.15	0.09	210	9	2.60	0.12	0.95	3.50
5/17/83	103.0	0.05	--	0.04	160	3.20	1.00	0.47	4.20

5/13/86	25.0	0.11	0.01	0.01	160	--	0.40	0.38	2.90
6/12/84	24.0	0.04	--	0.02	150	3.20	0.80	0.98	4.00
6/13/85	20.0	0.04	--	0.01	170	3.00	0.50	0.43	3.50
6/2/87	20.0	0.02	0.01	160	3	- -	0.04	1.00	3.60
7/16/80	0.2	0.22	0.05	220	30	0.31	0.01	1.30	1.70
7/14/81	0.3	0.24	0.15	150	10	1.00	0.17	0.86	2.10
7/20/82	3.2	0.20	0.19	180	3	1.20	0.06	1.80	3.10
7/12/83	18.0	0.05	--	0.03	150	2.70	0.90	0.96	3.80
7/10/84	25.0	0.04	--	0.01	150	3.30	0.60	0.74	3.90
7/24/85	22.0	0.05	--	0.02	100	3.20	0.90	0.84	4.10
7/22/86	22.0	0.03	0.02	0.01	160	- -	0.40	0.37	3.30
7/7/87	17.0	0.58	0.02	150	3	- -	0.04	0.80	3.30
8/1/79	0.3	0.07	0.10	210	20	1.40	0.07	0.72	2.10
8/30/83	20.0	0.03	--	0.02	160	3.20	0.50	0.78	3.60
8/27/84	22.0							0.58	
8/11/87	15.0	0.09	0.01	160	3	2.20	0.02	0.40	2.70
9/4/79	0.0	0.14	0.10	270	10	0.54	0.10	0.68	1.30
9/10/80	0.5	0.22	0.16	240	10	1.20	0.03	0.90	2.10
9/1/81	0.3	0.24	0.09	180	10	1.40	0.09	0.93	2.40
9/8/82	2.8	0.09	0.08	100	40	0.35	0.13	0.77	1.40
9/11/85	20.0	0.05	--	0.02	150	3.20	0.70	0.65	3.90
9/23/86	23.0	0.08	0.05	0.02	170	- -	0.40	- -	3.50
11/18/80	0.2	0.30	0.20	150	90	1.20	0.02	0.95	2.20
11/17/81	128.0	0.20	0.14	60	34	0.98	0.16	0.53	1.70
11/16/82	14.0	0.28	0.17	110	7	1.60	0.06	1.30	3.10
12/6/86	27.0	0.15	- -	120	51	- -	0.03	1.00	3.20
12/30/81	27.0	0.21	0.11	90	20	1.20	0.10	0.69	2.00

STATION #11169000 GAUDALUPE RIVER AT SAN JOSE, CALIF.

Period	Flow (cfs)	Total Phosphorous (mg/l as P)	Dis Ortho P (mg/l as P)	Boron (mg/l as B)	Iron (mg/l as Fe)	Nitrogen NO3+NO2 (mg/l as N)	Dis. Ammonia (mg/l as N)	Total Organic (mg/l as N)	Total Nitrogen (mg/l as N)
All									
Mean	341.6	0.22	0.09	87.2	74	1.59	0.30	0.95	2.74
CV	3.32	1.69	0.68	1.03	0.86	0.61	1.14	0.60	0.35
n	64	63	47	63	63	51	62	61	62
Month									
Nov	42.3	0.23	0.17	110.0	46	1.26	0.07	0.95	2.55
Jan	281.3	0.22	0.12	61.7	81	1.84	0.23	0.90	2.98
Feb	1171.2	0.42	0.07	48.9	80	0.95	0.47	1.22	2.54
Mar	613.8	0.24	0.08	59.2	75	1.10	0.31	1.06	2.21
May	22.9	0.11	0.06	139.0	76	2.09	0.32	0.83	3.11
July	12.0	0.16	0.09	101.1	70	1.87	0.35	0.93	3.04
August	14.3	0.06	0.06	123.3	61	2.27	0.20	0.62	2.80
Sept	7.8	0.14	0.10	131.7	65	1.34	0.24	0.79	2.43
Winter									
Nov-Apr	579.8	0.28	0.10	63.0	75	1.35	0.30	1.04	2.57
n	37	37	29	37	37	30	36	35	36
Summer									
May-Sept	15.7	0.13	0.08	120.4	72	1.91	0.31	0.83	2.94
n	28	27	19	27	27	22	27	27	27

STATION 11 169000 - GUADALUPE RIVER AT SAN JOSE, CALIF.

GROUP A - PRESENT IN STREAM

DATE	FLOW	DIAZINON TOTAL (UG/L)	2,4-D TOTAL (UG/L)	LINDANE TOTAL (UG/L)	MALATHION TOTAL (UG/L)
1/17/79	52.00	0.07	0.07	0.02	0.00
8/1/79	0.33	0.20	0.11	0.01	0.00
2/19/80	7900.00	0.07	0.07	0.02	0.01
9/10/80	0.53	0.03	0.00	0.01	0.00
3/27/81	3.70	0.34	0.17	0.02	0.22
9/1/81	0.33	0.02	0.02	0.00	0.96
1/5/82	943.00	0.07	0.02	0.01	0.09
9/8/82	2.80	0.16	0.02	<0.010	<0.01
1/27/83	1540.00	< 0.01	< 0.01	<0.010	<0.01
4/12/83	61.00	0.01	0.03	<0.010	<0.01
8/30/83	20.00	0.02	0.05	<0.010	<0.01
8/27/84	22.00	0.01	0.04	<0.010	<0.01
2/9/85	116.00	0.09	0.07	0.04	0.01
9/11/85	20.00	0.04	< 0.01	<0.010	<0.01
1/29/86	25.00	0.18	0.01	<0.010	0.03
2/13/86	124.00	0.10	0.10	<0.010	0.01
2/24/86	925.00	< 0.01	< 0.01	<0.010	<0.01
7/22/86	22.00	0.01	0.11	<0.010	<0.01
9/23/86	23.00	0.02	0.03	<0.010	<0.01
ALL - AVG		0.08	0.05		
COV		1.14	0.92		
mid 82 - 86					
winter		0.08	0.04	see data	see data
summer		0.04	0.04	all < 0.010	all < 0.01
79 - mid 82					
winter		0.14	0.08	0.02	0.08
summer		0.08	0.04	0.01	0.32

STATION 11 169000 - GUADALUPE RIVER AT SAN JOSE, CALIF.

GROUP B - SOME POSITIVE BEFORE MID 1982 - NONE > D.L. AFTER

DATE	FLOW	CHLORODANE TOTAL (UG/L)	DDD TOTAL (UG/L)	DDE TOTAL (UG/L)	DDT TOTAL (UG/L)	DIELDRIN TOTAL (UG/L)	HEPTACHLOR TOTAL (UG/L)
1/17/79	52.00	0.00	0.00	0.00	0.00	0.00	0.00
8/1/79	0.33	0.00	0.00	0.00	0.00	0.00	0.00
2/19/80	7900.00	0.60	0.04	0.04	0.11	0.02	0.02
9/10/80	0.53	0.10	0.01	0.00	0.00	0.00	0.00
3/27/81	3.70	0.10	0.00	0.00	0.00	0.00	0.00
9/1/81	0.33	0.00	0.00	0.00	0.00	0.00	0.00
1/5/82	943.00	0.00	0.01	0.01	0.00	0.00	0.00
9/8/82	2.80	<0.1	<0.010	<0.010	<0.010	<0.010	<0.010
1/27/83	1540.00	<0.1	<0.010	<0.010	<0.010	<0.010	<0.010
4/12/83	61.00	<0.1	<0.010	<0.010	<0.010	<0.010	<0.010
8/30/83	20.00	<0.1	<0.010	<0.010	<0.010	<0.010	<0.010
8/27/84	22.00	<0.1	<0.010	<0.010	<0.010	<0.010	<0.010
2/9/85	116.00	<0.1	<0.010	<0.010	<0.010	<0.010	<0.010
9/11/85	20.00	<0.1	<0.010	<0.010	<0.010	<0.010	<0.010
1/29/86	25.00	<0.1	<0.010	<0.010	<0.010	<0.010	<0.010
2/13/86	124.00	<0.1	<0.010	<0.010	<0.010	<0.010	<0.010
2/24/86	925.00	<0.1	<0.010	<0.010	<0.010	<0.010	<0.010
7/22/86	22.00	<0.1	<0.010	<0.010	<0.010	<0.010	<0.010
9/23/86	23.00	<0.1	<0.010	<0.010	<0.010	<0.010	<0.010

STATION 11 169000 - GUADALUPE RIVER AT SAN JOSE, CALIF.

GROUP C - NEVER DETECTED

DATE	ENDO-SULFAN TOTAL (UG/L)	ENDRIN TOTAL (UG/L)	ETHION TOTAL (UG/L)	CHLOR EPOXIDE TOTAL (UG/L)	OXY-CHLOR TOTAL (UG/L)	METHYL PARA-THION TOTAL (UG/L)	METHYL TRI-THION TOTAL (UG/L)	MIREX TOTAL (UG/L)	PER-THANE TOTAL (UG/L)	TOXA-PHENE TOTAL (UG/L)	TOTAL TRI-THION (UG/L)	245-T TOTAL (UG/L)	SILVEX TOTAL (UG/L)	NAPHTH-ALENES POLYCHL TOTAL (UG/L)	PCB TOTAL (UG/L)
Jan-79	0.00	0.00	0.00	0.00	--	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	--	0.00
Aug-79	0.00	0.00	0.00	0.00	--	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.05	--	0.00
Feb-80	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.00
Sep-80	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00
Mar-81	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sep-81	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Jan-82	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sep-82	<0.010	<0.010	<0.01	<0.010	<0.01	<0.01	<0.01	<0.01	<0.1	<1	<0.01	<0.01	<0.01	<0.10	<0.1
Jan-83	<0.010	<0.010	<0.01	<0.010	<0.01	<0.01	<0.01	<0.01	<0.1	<1	<0.01	<0.01	<0.01	<0.10	<0.1
Apr-83	<0.010	<0.010	<0.01	<0.010	<0.01	<0.01	<0.01	<0.01	<0.1	<1	<0.01	<0.01	<0.01	<0.10	<0.1
Aug-83	<0.010	<0.010	<0.01	<0.010	<0.01	<0.01	<0.01	<0.01	<0.1	<1	<0.01	<0.01	<0.01	<0.10	<0.1
Aug-84	<0.010	<0.010	<0.01	<0.010	<0.01	<0.01	<0.01	<0.01	<0.1	<1	<0.01	<0.01	<0.01	<0.10	<0.1
Feb-85	<0.010	<0.010	<0.01	<0.010	<0.01	<0.01	<0.01	<0.01	<0.1	<1	<0.01	<0.01	<0.01	<0.10	<0.1
Sep-85	<0.010	<0.010	<0.01	<0.010	<0.01	<0.01	<0.01	<0.01	<0.1	<1	<0.01	<0.01	<0.01	<0.10	<0.1
Jan-86	<0.010	<0.010	<0.01	<0.010	<0.01	<0.01	<0.01	<0.01	<0.1	<1	<0.01	<0.01	<0.01	<0.10	<0.1
Feb-86	<0.010	<0.010	<0.01	<0.010	<0.01	<0.01	<0.01	<0.01	<0.1	<1	<0.01	<0.01	<0.01	<0.10	<0.1
Feb-86	<0.010	<0.010	<0.01	<0.010	<0.01	<0.01	<0.01	<0.01	<0.1	<1	<0.01	<0.01	<0.01	<0.10	<0.1
Jul-86	<0.010	<0.010	<0.01	<0.010	<0.01	<0.01	<0.01	<0.01	<0.1	<1	<0.01	<0.01	<0.01	<0.10	<0.1
Sep-86	<0.010	<0.010	<0.01	<0.010	<0.01	<0.01	<0.01	<0.01	<0.1	<1	<0.01	<0.01	<0.01	<0.10	<0.1

STATION 11 169000 GUADALUPE RIVER

GROUP #1

DATE	FLOW CFS	Zn dissolved ug/l	Zn sediment ug/gm	PB dissolved ug/l	PB sediment ug/gm	Cu dissolved ug/l	Cu sediment ug/gm	As dissolved ug/l	As sediment ug/gm
1/17/79	52.0	20	--	26	--	3	--	1	--
1/5/82	943.0	10	100	6	60	2	30	2	8
1/27/83	1540.0	6	70	1	80	2	20	1	4
1/28/88	24.0	8	- -	5	- -	2	- -	2	- -
2/19/80	7900.0	190	810	0	1000	2	40	2	8
2/9/85	116.0	3	110	2	80	3	180	1	4
2/13/86	124.0	28	--	1	--	3	--	1	--
2/24/86	925.0	20	--	1	--	1	--	1	--
3/27/81	3.7	20	70	3	20	6	20	3	10
8/1/79	0.3	6	--	ND	--	2	--	2	--
8/30/83	20.0	9	50	1	40	1	10	1	2
8/27/84	22.0	6	120	1	50	1	60	1	1
8/11/88	15.0	3	100	5	40	1	30	1	5
9/10/80	0.5	10	40	2	40	2	20	4	16
9/1/81	0.3	40	120	5	110	2	100	2	7
9/8/82	2.8	30	70	1	60	5	10	2	3
9/11/85	20.0	10	190	1	300	1	100	1	7
ALL DATA									
AVG	688.7	25	154	3.8	157	2.3	52	1.6	6.3
COV	2.78	1.78	1.36	1.63	1.76	0.61	0.99	0.52	0.65
WINTER									
AVG	1292.0	34	232	5.0	248	2.7	58	1.6	6.8
COV	1.96	1.74	1.39	1.62	1.70	0.53	1.18	0.47	0.39
SUMMER									
AVG	10.1	14	99	2.3	91	1.9	47	1.8	5.9
COV	0.99	0.93	0.52	0.83	1.04	0.72	0.85	0.59	0.86

STATION 11 169000 GUADALUPE RIVER

GROUP #2 - NOT ENVIRONMENTALLY SIGNIFICANT

DATE	FLOW CFS	FE sediment ug/gm	Mn dissolved ug/l	Mn sediment ug/gm	Al dissolved ug/l	Al sediment ug/gm	Co sediment ug/gm
1/17/79	52.0	--	4	--	10	--	--
1/5/82	943.0	16000	20	330	40	9500	20
1/27/83	1540.0	7000	10	350	120	3900	20
1/28/88	24.0	- -	10	- -	10		- -
2/19/80	7900.0	13000	10	400	60	700	30
2/9/85	116.0	30000	8	500	20	12000	20
2/13/86	124.0	--	5	--	10	--	--
2/24/86	925.0	--	10	--	40	--	--
3/27/81	3.7	7500	20	190	20	4200	20
8/1/79	0.3	--	30	--	50	--	--
8/30/83	20.0	6500	12	200	10	3500	10
8/27/84	22.0	22000	10	390	10	9300	20
8/11/88	15.0	13000	9	370	10		<50
9/10/80	0.5	10000	0	540	10	3100	30
9/1/81	0.3	16000	0	310	10	5000	20
9/8/82	2.8	4500	20	150	10	49000	<10
9/11/85	20.0	21000	20	660	10	12000	20
ALL DATA							
AVG	688.7	13,875	12	366	26	10,200	21
COV	2.78	0.55	0.69	0.41	1.10	1.32	0.27
WINTER							
AVG	1292.0	14,700	11	354	37	6,060	22
COV	1.96	0.64	0.53	0.32	0.97	0.76	0.20
SUMMER							
AVG	10.1	13,286	13	374	15	13,650	20
COV	0.99	0.51	0.82	0.48	0.94	1.29	0.35

STATION 11 169000 GUADALUPE RIVER

GROUP #3 - BELOW DETECTION LIMIT

DATE	FLOW CFS	Ni dissolved ug/l	Cr dissolved ug/l	Cr sediment ug/gm	Cd dissolved ug/l	Cd sediment ug/gm	Hg dissolved ug/l	Hg sediment ug/gm	Se dissolved ug/l	Se sediment ug/gm
1/17/79	52.0	ND	ND	--	2	--	<0.1	--	--	--
1/5/82	943.0	<100	<10	60	1	1	<0.1	1.7	--	<1
1/27/83	1540.0	<100	<10	30	<1	1	<0.1	3.5	--	<1
1/28/88	24.0	<1	<1	- -	<1	- -	<.1	- -	1	- -
2/19/80	7900.0	0	0	50	0	2	0	1.7	--	0
2/9/85	116.0	<100	<10	90	<1	<1	<0.1	0.3	<1	<1
2/13/86	124.0	<100	<10	--	<1	--	<0.1	--	--	--
2/24/86	925.0	<100	<10	--	<1	--	<0.1	--	--	--
3/27/81	3.7	0	10	21	1	0	0	0.4	--	0
8/1/79	0.3	ND	ND	--	<2	--	<0.1	--	--	--
8/30/83	20.0	<100	<10	20	<1	<1	<0.1	0.03	--	<1
8/27/84	22.0	<100	<10	80	<1	<1	<0.1	0.9	--	<1
8/11/88	15.0	<1	2	50	<1	1	<.1	1.7	3	<1
9/10/80	0.5	0	0	43	0	2	0	10	--	0
9/1/81	0.3	0	0	50	0	<1	0	0.36	--	0
9/8/82	2.8	<100	<10	10	<1	<1	<0.1	0.08	--	<1
9/11/85	20.0	<100	--	740	1	0	<0.1	1.7	--	1

APPENDIX G
POINT SOURCE LOADS

APPENDIX G
POINT SOURCE LOADS

G.1 WASTEWATER TREATMENT PLANT LOADS

Annual loads were estimated for the three Lower South Bay wastewater treatment plants (San Jose/Santa Clara, Sunnyvale, Palo Alto) based on self-monitoring data provided by the Regional Board for 1987 and 1988. The data, shown in Table G-1, give for each year the number of samples, the number of samples below the detection limit, the average concentration, and the load for each plant. The total annual load is then computed in the right-hand column. Loads were estimated using synoptic rather than average flow measurements. The mean annual flows for each treatment plant are also provided at the top of each table.

When the majority of samples are below detection, the estimated load is uncertain and conservative because the concentration was assumed to equal the detection limit, whereas the actual concentration is between zero and the detection limit. Comparisons with nonpoint source loads were made only for those constituents which were consistently measured at levels well above detection limits.

G.2 OTHER POINT SOURCES

There are a number of point source discharges to the area streams, operating under NPDES Permits. These are facilities which pump contaminated groundwater from the aquifer, subject it to treatment to remove contaminants, and then discharge to a stream, often via a storm drain. All of the identified discharges are upstream of the stream

Table G-1. ESTIMATED ANNUAL LOADS FOR WASTEWATER TREATMENT PLANTS FOR 1987 AND 1988

1987

	PALO ALTO WWTP Qave=25.7 MGD				SAN JOSE SANTA CLARA WWTP Qave=121 MGD				SUNNYVALE WWTP Qave=17.6MGD				
COMTAMINANT	NO. OF DATA POINTS	NO. OF BDL VALUES	AVE. CONC. (µg/l)	TOTAL ANNUAL LOAD (LB.)	NO. OF DATA POINTS	NO. OF BDL VALUES	AVE. CONC. (µg/l)	TOTAL ANNUAL LOAD (LB.)	NO. OF DATA POINTS	NO. OF BDL VALUES	AVE. CONC. (µg/l)	TOTAL ANNUAL LOAD (LB.)	TOTAL LOAD (all plants LB.)
ARSENIC	12	11	5	376	4	0	3	995	1	0	4	214	1,585*
CADMIUM	12	11	6	454	4	0	3	921	3	2	0	21	1,397*
CHROMIUM	12	4	7	532	4	0	4	1,401	48	2	5	252	2,185
COPPER	12	1	38	2,990	4	0	13	4,718	50	0	21	1,110	8,818
LEAD	10	2	12	916**	4	0	16	5,897	47	5	3	177	6,990**
MERCURY	12	8	1	39	4	4	0	111	-	-	-	0	++
NICKEL	12	1	20	1,589	4	0	25	8,986	49	0	25	1,335	11,910
SELENIUM	2	1	3	235	2	2	1	359	-	-	-	0	++
SILVER	11	1	11	830	4	0	2	553	49	5	1	70	1,452
ZINC	12	0	65	5,104	4	0	51	18,613	50	0	40	2,139	25,856
AMMONIA	12	0	1,800	140,911	12	0	1,600	589,720	12	0	3,300	176,916	907,547
CYANIDE	7	5	23	1,801	6	6	100	+	3	2	10	536	+
OIL & GREASE	12	0	800	62,627	12	0	700	258,002	12	6	1,700	91,138	411,768
PHENOLS	4	4	17	1,315	4	0	2	811	-	-	-	0	++

Note: For the estimation of the total annual loads, if the concentration was BDL (Below Detection limit), the value used to estimate the load was the detection limit, therefore the load estimate is a maximum.

* Load estimates subject to much uncertainty because most concentrations were BDL

** Total annual load for Palo Alto WWTP based on conc. from Jan-Oct (Nov and Dec were 100 ug/L which appear to be unusually high

+ Load estimate not made because of unusually high detection limit (100 ug/l), at San Jose Santa Clara WWTP, and most concentrations were BDL.

++ Total load for all plants not calculated because no data was reported from Sunnyvale WWTP

Table G-1(continued). **ESTIMATED ANNUAL LOADS FOR WASTEWATER TREATMENT PLANTS FOR 1987 AND 1988**

1988

	PALO ALTO WWTP Qave=23.5 MGD				SAN JOSE SANTA CLARA WWTP Qave=118MGD				SUNNYVALE WWTP Qave=16.8MGD				
COMTAMINANT	NO. OF DATA POINTS	NO. OF BDL VALUES	AVE. CONC. (μg/l)	TOTAL ANNUAL LOAD (LB.)	NO. OF DATA POINTS	NO. OF BDL VALUES	AVE. CONC. (μg/l)	TOTAL ANNUAL LOAD (LB.)	NO. OF DATA POINTS	NO. OF BDL VALUES	AVE. CONC. (μg/l)	TOTAL ANNUAL LOAD (LB.)	TOTAL LOAD (all plants LB.)
ARSENIC	12	3	3	222	12	0	2	719	52	52	1	51	992*
CADMIUM	12	12	5	358	12	0	3	899	52	52	1	51	1,308*
CHROMIUM	12	2	7	501	12	0	4	1,330	52	52	3	138	1,969*
COPPER	12	1	31	2,219	12	0	13	4,601	52	0	17	870	7,690
LEAD	12	4	17	1,217	12	0	19	6,829	52	0	7	358	8,408
MERCURY	12	10	1	36	12	12	0	72	52	52	1	51	159*
NICKEL	12	6	15	1,074	12	0	29	10,424	52	0	24	1,228	12,726
SILVER	12	6	5	379	12	0	2	719	52	52	2	102	1,201*
ZINC	12	0	71	5,082	12	0	62	22,249	52	52	36	1,842	29,174*
NITRATE	12	0	15,000	1,073,741	12	0	19,700	7,080,900	49	0	9,800	501,505	8,656,146
TKN	12	0	2,200	157,482	12	0	2,700	970,479	25	0	7,600	388,923	1,516,883
PHOSPHATE	12	0	18,300	1,309,964	12	0	17,400	6,254,196	25	0	21,500	1,100,241	8,664,401
TSS	12	0	4,700	336,439	12	0	1,200	431,324	164	0	11,000	562,914	1,330,677
BOD	12	0	3,100	221,906	12	0	4,000	1,437,746	164	0	5,780	295,786	1,955,438
AMMONIA	12	0	1,400	100,216	12	0	1,500	539,155	54	0	3,500	179,109	818,480
CYANIDE	4	0	20	1,432	12	12	100	+	52	52	10	512	+
OIL & GREASE	11	0	700	50,108	12	0	700	251,606	50	9	3,090	158,128	459,841
PHENOLS	4	0	46	3,314	4	0	1	467	52	0	40	2,047	5,829

Note: For the estimation of the total annual loads, if the concentration was BDL (Below Detection limit), the value used to estimate the load was the detection limit, therefore the load estimate is a maximum.

* Load estimates subject to much uncertainty because most concentrations were BDL

+ Load estimate not made because of unusually high detection limit (100 ug/l), at San Jose Santa Clara WWTP, and most concentrations were BDL.

++ Total load for all plants not calculated because no data was reported from Sunnyvale WWTP monitoring stations used in the study, and would therefore influence the conditions at the station, primarily during dry weather periods.

As part of their permit requirements, these plants submit regular reports providing information on discharge quantity and quality. For this study, WCC obtained and reviewed these reports for each of the facilities which discharge, covering a substantial portion of 1987. This source was useful in establishing the approximate rate and total volume of discharge by these point sources. There are usually a large number of flow observations reported, and the degree of fluctuation between observations is nominal, so that the average that was computed for use in the load estimates is considered to provide a suitable indicator of the quantity of treated groundwater discharged to the streams.

Characterization of the quality of these discharges is a different matter. The principal constraint imposed by the data in the Permit reports is that the laboratory analyses performed examined only organic compounds (the pollutants of concern at these sites), and, following treatment, all concentrations reported (with isolated occasional exceptions) were below detection levels.

To address this limitation, the RWQCB requested the facilities involved to conduct a special supplementary survey to provide information on heavy metal levels in the discharge. Heavy metals are a normal component of urban runoff and this information would provide a common element to use for comparisons of sources. Results from the single sample analyzed by these special studies were reviewed, and the concentrations observed were combined with the discharge flows from the more comprehensive flow records, to compute estimates of the pollutant loads from the point sources.

These results are summarized by Table G-2. Facilities are organized by stream, and the discharge rate and concentrations of observed pollutants are listed. Copper and zinc are selected for load computations because

TABLE G-2 SUMMARY OF POINT SOURCE POLLUTANT DISCHARGES

Wet Seas - days= 212 Oct - Apr
Dry Seas - days= 153 May-Sept

CALABAZAS STA S-1

			Pollutant Conc µg/l			Season Pollutant Load (lbs) WET (212 da)		dry (153 da)	
PS Facility	Disch Q (gpm)	Disch Q (cfs)	Cu	Zn	other rep'td	Cu	Zn	Cu	Zn
1 Unocal	4	0.009		170	As 6 ; Se 9	0	1.7	0	1.2
2 Hewlett Packard	1.5	0.003			Se 5	0	0	0	0
3 Nat'l Semicond	75	0.167			org - approx 10	0	0	0	0
4 Intersil	0.64	0.001		134	-	0	0.2	0	0.2
5 Siemens	18.8	0.042	152	331	-	7.2	15.8	5.2	11.4
6 Signetics	201	0.448		60	-	0	30.5	0	22.0
PS Total	301	0.670	9.5	63		7.2	48.2	5.2	34.8

SUNNYVALE EAST STA S-2

			Pollutant Conc µg/l			Season Pollutant Load (lbs) WET (212 da)		dry (153 da)	
PS Facility	Disch Q (gpm)	Disch Q (cfs)	Cu	Zn	other rep'td	Cu	Zn	Cu	Zn
1 Signetics	75	0.167		30		0	5.7	0	4.1
2 Signetics	85	0.189		60		0	12.9	0	9.3
3 Adv Micro	98	0.218			Pb 55; Ag 19; 245	0	0	0	0
4 TRW	26	0.058	5.5	35	-	0.4	2.3	0.3	1.7
PS Total	284	0.633	0.5	29		0.4	20.9	0.3	15.1

GUADALUPE STA S-3

			Pollutant Conc µg/l			Season Pollutant Load (lbs) WET (212 da)		dry (153 da)	
PS Facility	Disch Q (gpm)	Disch Q (cfs)	Cu	Zn	other rep'td	Cu	Zn	Cu	Zn
1 IBM	1406	3.133		33	Se 6; org 1 to 30	0	117.5	0	84.8
2 Fairchild	1054	2.348			TCE 1.2	0	0	0	0
3 Lincoln Prop	250	0.557	21	39	Se 4 ; As 1	13.3	24.7	9.6	17.8
PS Total	2710	6.038	2	21		13.3	142.2	9.6	102.6

COYOTE STA S-4

			Pollutant Conc µg/l			Season Pollutant Load (lbs) WET (212 da)		dry (153 da)	
PS Facility	Disch Q (gpm)	Disch Q (cfs)	Ni	Zn	other rep'td	Ni	Zn	Ni	Zn
1 So Pacific Pipe	2400	5.347	130		Cd 13	790	0	570	0
2 SC Co Transit	0.1	0.000		90		0	0.023	0	0.016
PS Total	2400	5.347	130	0.004		790	0.023	570	0.016

they are the only metals that appear to be present often enough to include in a watershed summary. Coyote Creek is a partial exception, in that nickel, rather than copper is present. Zinc appears to be the only heavy metal that is observed in most of the discharges.

The flows are assumed to be uniform throughout the year, and the mass loads computed from the listed flows and concentrations are shown for the wet and dry seasons. These results are presented for each discharge, as is the total for all the discharges upstream of each stream monitoring station. The concentrations shown for the PS total for the watershed are the flow weighted concentrations for the composite point source discharges above each station, which could be compared with the measured concentrations at the station. Chapter 8 of the report discusses the influence of the presence of pollutants from upstream point sources on the projections of loads from watersheds that do not contain such facilities.

APPENDIX H

ANALYSIS OF UNCERTAINTY IN LOAD ESTIMATES

APPENDIX H
ANALYSIS OF UNCERTAINTY IN LOAD ESTIMATES

The annual nonpoint source load estimates presented in Section 8 were derived from simulated flows and measured concentration data. Because the exact values of flows and concentrations are not known, annual load estimates have some degree of uncertainty associated with them. In this appendix we describe and quantify this uncertainty, so that future decisions and analyses can be based on both the loads estimates and their associated confidence levels.

The sources of uncertainty in loads estimates are summarized and discussed in Section H.1. Section H.2 then presents the procedures used to quantify uncertainty. Section H.3 discusses the results of the quantitative uncertainty analysis in terms of confidence bounds on annual load estimates for the entire valley.

H.1 SOURCES OF UNCERTAINTY

For the purposes of this study, annual loads are estimated as the product of annual flow volume and mean concentrations for each land use. Thus, uncertainty in the load arises from (1) uncertainty in the estimate of flow from each watershed and land use, and (2) uncertainty in the estimate of mean concentrations for each land use.

H.1.1 Uncertainty in Flow Estimates

Storm runoff flow volumes were estimated in this study using the rainfall-runoff model SWMM, as described in Appendix B. In watersheds where flow data were available, the model was calibrated to match observed flow volumes. In watersheds where no flow data were available, the model was applied using input data from similar calibrated watersheds. The following factors contribute to uncertainty in flow estimates:

1. Model input parameters are not known exactly,
2. The model itself is an inexact representation of the actual hydrologic processes,
3. The measured flows used in calibration of the model are not exact.

Calibration of the model against observed flows attempts to minimize the first two components of flow uncertainty. However, as described in Appendix B it is not possible to arrive at a perfect calibration for any one watershed. Root Mean Square Errors (RMSEs) in annual load estimates generally ranged from 15 to 25 percent, but were as high as 40 percent in some watersheds. Errors in uncalibrated watersheds would be expected to be higher.

Even if the calibration resulted in a perfect match with observed flows, there would be some uncertainty associated with errors in flow measurements. The magnitude of these errors is currently unknown, but is assumed to be small relative to calibration errors in most watersheds. A possible exception to this is the Guadalupe River, where flow measurements were found to be inconsistent with reservoir release data (see Section 5.3.2 for a detailed discussion).

H.1.2 Uncertainty in the Mean Concentration

The annual mean concentrations for each land use and constituent were estimated from the sampling data collected during the 1987-88 and 1988-89 monitoring periods. The following factors contribute to the uncertainty in the estimated mean concentrations:

1. **Mean concentrations for each land use were estimated from a finite number of water quality samples (generally less than 25).** Statistically, the degree of uncertainty in the mean decreases with large samples sizes, and increases as the sample variance increases. For industrial and open land uses, mean concentrations were estimated based on 5 or fewer samples.

2. **Measured concentrations are subject to laboratory and field sampling errors.** As discussed in Section C.4, laboratory QA/QC data indicated the data collected in this study are of good and reliable quality. Relative percent differences (RPDs) between field duplicates were on average 29 percent, and ranged from 0 to 100 percent. For laboratory duplicates, relative percent differences were on average 16 percent, and ranged from 0 to 40 percent.

3. **Data collected during the 1987-88 and 1988-89 monitoring periods may not be representative of other years with higher rainfall.** The monitoring period for this study unfortunately coincided with several years of drought in California. Thus, there is the concern that water quality in wet and normal years might differ significantly from data collected during dry years. As discussed in Section 8.6.4, dry years differ from wet years primarily in terms of the number of storms, not the volume of storms. Data collected during the monitoring period suggest little relationship between runoff volume, storm frequency, and concentration. However, buildup-washoff, water quality modeling results for Calabazas Creek (Appendix B) suggest that water quality is significantly different in wet years such as 1982-83 than in dry years such as the monitoring period. This component of uncertainty cannot be quantified until monitoring data are collected in wet years.

4. **Land use concentrations were corrected by loads correction factors to compensate for differences between land use and stream station concentrations.** As discussed in Section 8.6.2, the processes that might be explained by these loads correction factors are currently unknown. We

believe that these factors probably account for processes occurring within the stream bed. This component of uncertainty cannot be quantified until more data are collected on stream processes and stream bed water quality.

H.2 PROCEDURES USED TO QUANTIFY UNCERTAINTY

For this analysis, uncertainty is quantified by deriving confidence bounds on annual loads estimates, given the uncertainty in flow and concentration. A first-order, second moment approach is used, assuming that the distribution of load estimates for a given year can be described completely by the mean and variance of the estimates. Alternative methods for uncertainty analysis (e.g., Monte Carlo simulation) can give a more precise evaluation of uncertainty, but generally require more data and computational time than is practical for a modeling study of this scale.

The following sections describe the procedures and equations used in the analysis. Key assumptions include:

- Flow and concentration are assumed to be independent of each other.
- Uncertainty due to differences between water quality during the dry monitoring period and wetter years is not quantified, due to the lack of data. This component of uncertainty should be evaluated when wet-year water quality data are collected.
- Uncertainty due to stream bed processes is not evaluated, again due to lack of quantitative data on the effects of these processes.
- The mean and variance in flow estimates can be quantified using the model calibration errors, expressed as the ratio of observed to predicted annual flow volumes.

- The distribution of load estimates can be described completely by the mean estimate and the variance in estimates.

- In deriving confidence bounds, the distribution of errors in loads estimates is assumed to be Log Normal.

H.2.1 Uncertainty in Loads from a Single Land Use in a Watershed

The estimate of annual load from a single land use within a watershed is computed from the following model:

$$L_{ij} = Q_{ij}\,\bar{C}_j \qquad \text{(H-1)}$$

where

L_{ij} = the estimated load for a given year from watershed i, land use j

Q_{ij} = the estimated flow volume from watershed i, land use j

$\bar{C}_j$ = the estimated mean concentration for land use j

Because Q_{ij} and Cm_j are not precisely known, the expected value (or mean estimate) of L_{ij} is estimated by correcting the estimated flow by the mean calibration error:

$$\begin{aligned} E[L_{ij}] &= E[Q_{ij}]\,E[C_j] \\ &= (Q_{ij}\bar{e}_i)\bar{C}_j \end{aligned} \qquad \text{(H-2)}$$

where

E[] = expected value (or mean) of []

$\bar{e}_i$ = the mean flow model calibration error for watershed i, expressed as the mean ratio of observed to predicted flows

The variance of load estimates about this mean has two components. The first component, referred to as the intrinsic variance, accounts for the variability of flow and concentration estimates, assuming that the mean estimates of flow and concentration are known exactly:

$$\begin{aligned}\mathrm{Var}[L_{ij}]_{int} = {} & (Q_{ij}\bar{e}_i)^2\mathrm{Var}[C_j] + \bar{C}_j{}^2\mathrm{Var}[Q_{ij}] \\ & + \mathrm{Var}[Q_{ij}]\mathrm{Var}[C_j]\end{aligned} \qquad \text{(H-3)}$$

where

$$\mathrm{Var}[\,] = \text{variance of } [\,] \qquad \text{(H-4)}$$

The variance in C_j is simply the variance in the measured water quality samples for land use j, and accounts for both natural storm to storm variability and variability due to measurement (QA/QC) errors. The variance in Q_{ij} can be derived from the model calibration errors as follows:

$$\mathrm{Var}[Q_{ij}] = Q_{ij}{}^2\ \mathrm{Var}[e_i] \qquad \text{(H-5)}$$

where e_i is the ratio of observed to predicted flows for watershed i.

The second component of the uncertainty in load estimates is the parametric variance. The parametric variance accounts for the fact that the mean estimates of flow and concentration are derived from limited data sets, and are therefore uncertain:

$$\mathrm{Var}[L_{ij}]_{par} = \mathrm{Var}[\ E[Q_{ij}]\ E[C_j]\ ] \qquad \text{(H-6)}$$

$$\begin{aligned} = {} & (Q_{ij}\bar{e}_i)^2\mathrm{Var}[C_j]/n_c \\ & + \bar{C}m_j{}^2Q_{ij}{}^2\mathrm{Var}[e_i]/n_e \\ & + Q_{ij}{}^2\mathrm{Var}[e_i]\ \mathrm{Var}[C_j]/(n_en_c)\end{aligned}$$

where

n_c = number of concentration data
n_e = number of years of data used to estimate the mean model error

The total variance in load estimates for a given year is then given by the sum of the intrinsic and parametric variances:

$$Var[L_{ij}] = Var[L_{ij}]_{int} + Var[L_{ij}]_{par} \tag{H-7}$$

H.2.2 Uncertainty in Annual Loads Estimates for the Entire Study Area

The expected value of annual load estimates for the study area in year t is the sum of the mean load estimates for each watershed and land use in year t:

$$E[L_t] = \Sigma_i \Sigma_j E[L_{ij}] \tag{H-8}$$

where

$E[L_t]$ = the expected value of the load estimate for the study area in year t

Similarly, the variance in the estimate of the total annual load is the sum of the variances of load from each watershed and land use:

$$Var[L_t] = \Sigma_i \Sigma_j Var[L_{ij}] \tag{H-9}$$

H.2.3 Uncertainty in the Mean Annual Load Estimate

The mean annual load is the mean of the annual loads for the 12 year simulation period, and is estimated as follows:

$$E[L] = \Sigma_t E[L_t] / n_t \tag{H-10}$$

where

n_t = the number of years in the simulation period

The estimated mean is uncertain due to (1) the limited number of years of data used to estimate E[L], and (2) the parametric uncertainty in the mean estimates of flow and concentration. As a result, the variance in the mean annual load estimate is the sum of the sample variance of annual loads and the parametric variance:

$$\mathrm{Var}[\ E[L]\ ] = \Sigma_t\{(L_t - E[L])^2/(n_t-1) + \mathrm{Var}[L_t]_{par}\}/n_t \qquad \text{(H-11)}$$

H.2.4 Estimation of Confidence Bounds

The equations given above allow for the estimation of the mean estimate and the variance in estimates for (1) study area loads for any year t, and (2) the mean annual study area load. The next step in the analysis is to derive confidence bounds by assuming a distribution of estimates about the mean estimate. For this study, a log normal distribution of loads estimates was assumed. While there is no direct evidence that load estimates should be log normally distributed, this distribution is commonly observed in environmental data, and has the advantage of being bound by zero. Log normal distributions are described completely by the mean and variance.

H.2.5 Data Used in the Uncertainty Analysis

The uncertainty analysis described above requires (1) estimates of the flow model calibration errors, and (2) estimates of the mean and variance of concentrations for each land use and constituent.

Table H-1 summarizes the mean and variance of the model calibration error ratios (e_i) for each calibrated watershed. These were derived directly as the ratio of observed to predicted annual flow volumes for each calibration period. To quantify error ratios for uncalibrated watersheds, simulation experiments were conducted in which data from one calibrated

Table H-1. SUMMARY OF FLOW CALIBRATION ERROR RATIOS FOR EACH WATERSHED

Watershed	Mean Error (em_i)	Variance of Errors	Number of Values
Coyote Creek	1.01	0.20*	6*
Guadalupe River	1.22	1.11	9
San Tomas Aq. Cr.	1.20	0.09	12
Saratoga Creek	1.02	0.20	10
Calabazas Creek	1.02	0.04	11
Sunnyvale East Ch.	1.10	0.03	11
Stevens Creek	1.28	0.27	8
Ungaged Areas**	1.19	0.28	22

*Since only 1 year of calibration was available for Coyote Creek, the variance in error was estimated as the mean of the variances from the 6 other calibrated watersheds.

**Derived from simulation experiments on Sunnyvale East and San Tomas Aquinas Creek.

watershed were used to simulate runoff from a second calibrated watershed. Thus, the second watershed was treated as if it were uncalibrated. For these experiments, Sunnyvale East Channel was simulated using Calabazas Creek model data, and San Tomas Aquinas Creek was simulated using Saratoga Creek data. The resulting error ratios are summarized in Table H-1.

The means and variances of concentrations for each land use were obtained from statistical analysis of the sampling data, as described in Section 6. Table H-2 summarizes these for each land use and constituent.

H.3 RESULTS OF THE UNCERTAINTY ANALYSIS

Results of the uncertainty analysis for total loads from the study area are presented here as confidence bounds about the estimated load. Confidence bounds define the region in which one believes the true estimate of load lies, at a given level of confidence. Thus, 90 percent confidence bounds define the bounds between which one is 90 percent certain that the true value lies. Narrow confidence bounds imply a low level of uncertainty in an estimate, while wide confidence bounds imply high uncertainty.

Table H-3 summarizes the 90 percent confidence bounds for the mean annual total load estimate for each chemical parameter. In general, the 90 percent bounds are about plus or minus 50 to 60 percent away from the mean estimate. The relative widths of the bounds vary little among the different chemical parameters.

Note that these confidence bounds account only for uncertainty in flow estimates and in mean concentration estimates for land uses. They do not account for possible differences in water quality between wet and dry years, nor do they account for possible stream bed processes.

Table H-2. SUMMARY OF CONCENTRATION STATISTICS

LANDUSE TYPE	STATIONS	SEASON	Cadmium				Chromium				Copper				Lead				Nickel				ZINC			
			MEAN µg/L	median	CV	N	MEAN µg/L	median	CV	N	MEAN µg/L	median	CV	N	MEAN µg/L	median	CV	N	MEAN µg/L	median	CV	N	MEAN µg/L	median	CV	N
INDUSTRIAL	L2	WET	**5.9**	5.45	0.4	5	**39.1**	33.23	0.62	5	**52.9**	49.11	0.4	5	**133.5**	121.28	0.46	5	**54.0**	48.10	0.51	5	**1471.3**	1326	0.48	5
RESIDENTIAL/ COMMERCIAL	L1,L3,L4, L5,L6	WET	**1.7**	1.32	0.84	25	**21.1**	14.30	1.08	25	**50.5**	30.93	1.29	25	**60.8**	37.09	1.3	25	**40.9**	24.96	1.3	25	**251.3**	200	0.76	25
OPEN	L7	WET	**0.6**	0.43	0.98	5	**10.0**	7.92	0.77	5	**9.0**	7.37	0.7	5	**4.0**	2.45	1.3	5	**18.4**	11.21	1.3	5	**10.0**	7.96	0.76	5
RESERVOIRS	R-1,6	DRY	**0.3**	0.24	0.72	6	**6.7**	4.98	0.91	6	**6.3**	5.87	0.4	6	**1.9**	1.76	0.4	6	**8.3**	5.53	1.12	6	**8.0**	6.77	0.63	6
STREAM	S1	WET	**2.2**	1.95	0.49	5	**28.3**	21.91	0.82	5	**52.5**	46.80	0.51	5	**63.4**	38.67	1.3	5	**66.2**	47.50	0.97	5	**268.5**	249	0.4	5
	S2	WET	**2.3**	1.66	0.94	7	**41.7**	25.44	1.3	7	**69.1**	42.15	1.3	7	**64.5**	39.33	1.3	7	**51.8**	31.57	1.3	7	**336.9**	288	0.61	7
	S3	WET	**1.6**	1.36	0.66	6	**40.8**	24.88	1.3	6	**79.1**	48.22	1.3	6	**85.6**	52.18	1.3	6	**107.4**	65.46	1.3	6	**293.7**	179	1.3	6
	S4	WET	**3.2**	2.19	1.05	6	**45.2**	34.81	0.83	6	**65.6**	53.01	0.73	6	**82.0**	53.26	1.17	6	**98.5**	75.45	0.84	6	**263.0**	174	1.13	6
STREAM	S1,S2, S3,S4	DRY	**0.3**	0.28	0.46	12	**3.5**	2.86	0.72	12	**7.4**	4.60	1.25	26	**1.4**	1.24	0.47	26	**2.0**	2.00	-	12	**13.4**	10	0.81	26

Table H-2. SUMMARY OF CONCENTRATION STATISTICS (Concluded)

LANDUSE TYPE	STATIONS	SEASON	BOD MEAN mg/L	median	CV	N	NO3-N MEAN mg/L	median	CV	N	PO4-P MEAN mg/L	median	CV	N	TKN MEAN mg/L	median	CV	N	TSS MEAN mg/L	median	CV	N
INDUSTRIAL	L2	WET	12.7	11.8	0.4	5	0.6	0.5	0.41	2	1.9	0.7	0.4	2	1.8	1.6	0.4	4	151.7	134.1	0.53	5
RESIDENTIAL/ COMMERCIAL	L1,L3,L4, L5,L6	WET	10.0	8.3	0.67	25	0.7	0.6	0.4	6	0.7	0.3	0.4	6	2.1	1.8	0.61	20	76.1	65.8	0.58	24
OPEN	L7	WET	5.1	4.4	0.59	5	0.18			1	0.19			1	1.1	1.0	0.4	4	84.9	51.8	1.3	5
RESERVOIRS	R-1,6	DRY	5.1	4.4	0.59	5	0.3	0.2	1.03	5	0.3	0.1	0.4	6	1.0		-	1	46.7	28.5	1.3	3
STREAM	S1	WET	11.3	8.3	0.92	5	0.50		-	1	0.56		-	1	1.9	1.8	0.4	4	190.1	121.7	1.2	5
	S2	WET	17.3	11.8	1.07	6	0.51		-	1	0.90		-	1	2.1	1.9	0.4	3	234.2	142.8	1.3	6
	S3	WET	8.2	6.6	0.74	5	0.62		-	1	1.10		-	1	2.4	2.1	0.56	6	454.2	277.0	1.3	6
	S4	WET	10.8	7.8	0.95	5	0.89		-	2	0.73		-	2	1.5	1.4	0.4	5	248.3	206.3	0.67	5
STREAM	S1,S2, S3,S4	DRY	3.8	2.9	0.88	22	2.3	1.4	1.3	6	0.10		-	4	1.4	1.3	0.51	26	12.9	7.9	1.3	26

Table H-3. SUMMARY OF 90 PERCENT CONFIDENCE BOUNDS FOR MEAN ANNUAL LOAD ESTIMATES

CHEMICAL PARAMETER	MEAN ANNUAL LOAD (1000 lbs)	90 PERCENT BOUNDS LOWER (1000 lbs)	90 PERCENT BOUNDS UPPER (1000 lbs)
Cadmium	0.51	0.3	0.77
Chromium	9.7	5.3	17.7
Copper	14.6	8.4	24
Lead	14.6	8.6	23.7
Nickel	20.6	11.5	35.6
Zinc	50	31.2	77
BOD	2,110	1,500	3,840
NO3-N	206	102	360
PO4-P	161	147	216
TKN	378	294	744
TSS	68,600	43,400	133,000

As an example of how this information can be interpreted, the estimated mean annual copper loading is 14,600 lbs. Uncertainty results indicate that we can be 50 percent certain the actual mean annual load is between 11,500 and 17,600 lbs. We can be 90 percent certain the actual mean annual load is between 8400 and 24,000 lbs.

As an indication of how uncertainty varies year to year, Figure H-1 presents the confidence bounds about the estimated annual copper load for each of the twelve simulated years. As would be expected, confidence bounds tend to be wider for individual years than they are for the mean (i.e., we are more certain about the mean of the 12 annual load estimates than we are of any one year's load). 90 percent bounds are about plus or minus 95 percent away from the estimated value.

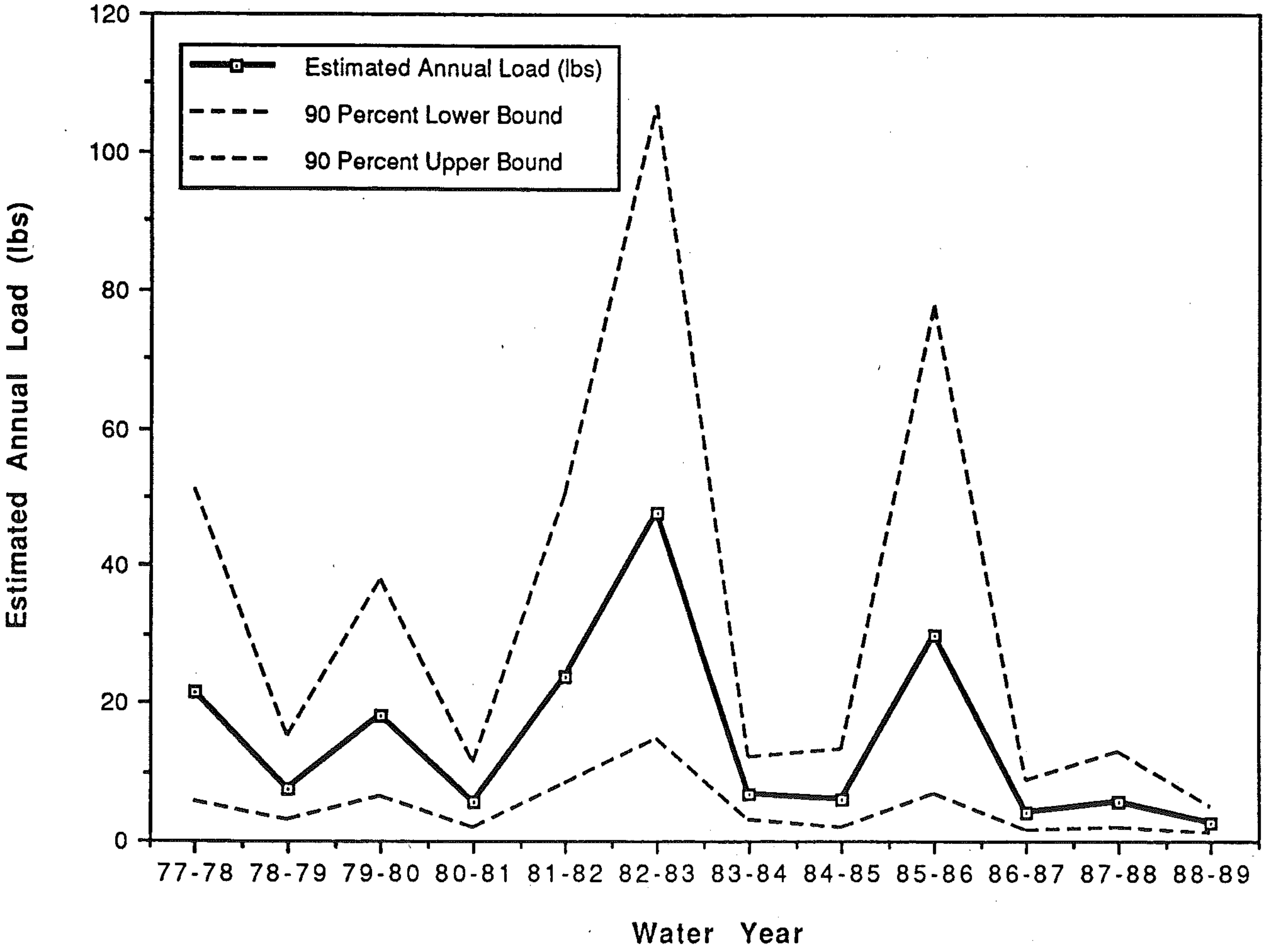


Figure H-1. 90 Percent Confidence Bounds on Annual Copper Loads